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The AUTOMOBILE

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No. 21

NEW YORK, MAY 25, 1916

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GRAY & DAVIS

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NEW YORK May 2, 1916.

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Chicago, Illinois, U. S. A.

VOL. XXXIV NEW YORK—THURSDAY, MAY 25, 1916—CHICAGO NO. 21

The AUTOMOBILE

Preparing for Hoosier Classic

Cars Late in Arriving at Track—The Three New Premiers in Detail—Frontenacs Form Featherweight Team with Their Aluminum Construction

By J. Edward Schipper

INDIANAPOLIS, IND., May 22—Ordinarily 8 days before the day of the race the speedway would be crowded with practising cars. This year, however, there is a difference, and it is only now that the cars are beginning to arrive at the scene of the great speed encounter.

Christiaens' Sunbeam and Barney Oldfield's Delage are, so far, the only cars actually on the track, and both of these are torn down while going through the final course of preparation for the 300-mile grind. The Sunbeam is the same car that ran in the Sheepshead Bay, N. Y., events of May 13, but it is now receiving some overhauling in order to remedy the weakness which put it out of the contest in New York. It will be remembered that this car was forced to abandon the race due to damage caused by the tachometer drive.

The tachometer is mounted on the end of the camshaft and the high speed caused a fracture of the aluminum case surrounding the end camshaft bearing, with a result that the oil ran out and a motor bearing seized. Christiaens has overcome this weakness, and prophecies that no little detail like that will again cause him to abandon the race.

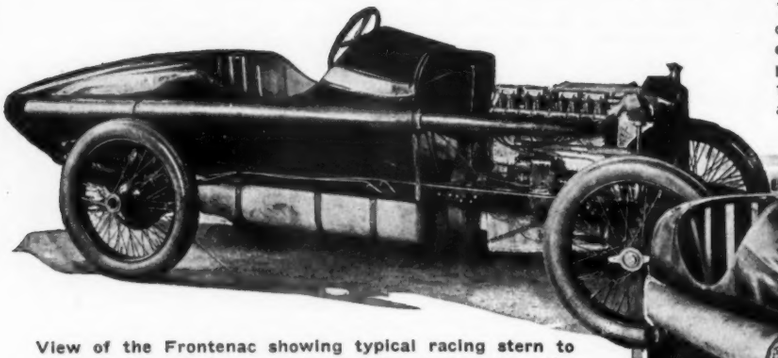
Indianapolis Race Entries

Car	Driver
Maxwell	Richenbacker
Maxwell	Henderson
Frontenac	Louis Chevrolet
Frontenac	Arthur Chevrolet
Frontenac	Gaston Chevrolet
Peugeot	Resta
Peugeot	Aitken
Peugeot	Merz
Peugeot	Mulford
Sunbeam	Christiaens
Sunbeam	Franchi
DuChesneau Special	DuChesneau
Richard	——
Premier	Anderson
Premier	Rooney
Premier	Stillman
Duesenberg	O'Donnell
Duesenberg	D'Alene
Crawford	Chandler
Crawford	Lewis
Crawford	Johnson
Delage	Oldfield
Delage	LeCain
Delage	Devigne
Erwin Forty	Bergdoll
Erwin Forty	Stecher
Ogren	Tom Alley
Duesenberg	Milton
Osteweg Special	Osteweg

Oldfield's Delage is the same car that has been described previously. He is tuning it for the race and making the many little modifications that racing drivers are always sure to do between events. There are no essential details changed.

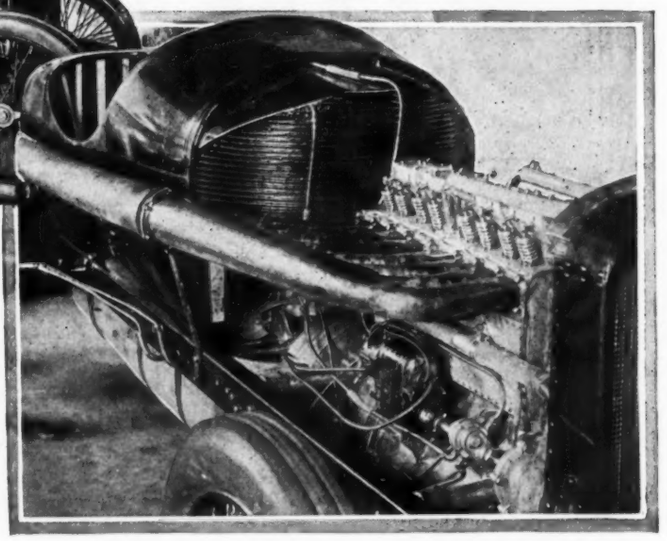
The Maxwell cars, of which there will be two, are just about due to arrive at the speedway, and these will immediately begin practice. It is felt by all the drivers who contested at New York that the personal element is going to enter this race much more than it did at Sheepshead Bay, and it will be necessary for all those who are going to drive to get out on the track as soon as possible in order to get an exact knowledge of the curves. On the 2-mile board saucer there was no shutting down on the curves. Here the turns will be coasted to a large extent. This means that the accelerative power of the cars is going to mean much to the drivers.

Probably the most interesting feature now in the vicinity of the track is taking place at the other end of town, in the factory of the Mais truck company. Here the new Premiers are being constructed and the Peugeots of Aitken and Merz being



View of the Frontenac showing typical racing stern to reduce wind resistance, the large exhaust pipe along the side and the gasoline tank below the frame

View of the right side of the Frontenac engine in the chassis. The exhaust header has eight individual openings from the valves. The view also shows the position of the main lubricant tank. This has copper fins in front to assist in cooling, and the draught is so arranged that all air going through the radiator must pass this tank



overhauled and fitted with new parts, wherever necessary.

The two Peugeots, as a matter of fact, are being fitted with Premier parts wherever they have been judged to be lacking in strength. The connecting-rods which have proved weak have been renewed and the oiling system completely overhauled. These are the main essentials; but, besides these, there have been a great many other refinements.

The three Frontenac entries for the Indianapolis grind are now completed and ready for their trials. Louis Chevrolet is the designer, and he has built three cars which are constructed more extensively of aluminum than any other motor vehicle yet to come before the public. Every conceivable unit or part of a unit that could be made of the material has a place in these Frontenacs, which as a result tip the scales at the surprisingly low weight of about 1750 lb.

Motor Nearly All Aluminum

The motor is almost all aluminum—cylinders, pistons, crankcase, intake manifold, camshaft cover and gear covers, water pump, oil pumps and other lesser parts are made of the metal—but this is not nearly all. The body, with its cigar-shaped stern, is a sheet aluminum affair; the main parts of the rear axle are cast from this light material, these being principally the gear housing and the brake flanges. Other aluminum parts are the clutch cone, transmission gearcase, pedal brackets, starting crank bracket and, last but not least, the long underpan.

A Real Test

Thus the Frontenacs will have to uphold the contentions of the aluminum exponents as no other cars in this year's speed contests will. On them will rest the proof of the value of the extensive use of the metal for severe service.

Chevrolet will drive one of the cars and Arthur and Gaston Chevrolet will be the pilots of the other two in the Indianapolis meet. Joseph Boyer is relief pilot.

Louis Chevrolet is chiefly responsible for the design. He fixes the horsepower of the new engine he is using at 135 to 140, resulting from a bore of 3.870 in. and a stroke of 6.375 in. He uses a compression of 105 lb. per square inch and has four valves per cylinder, inlets being 2 in. diameter and the exhausts 1¾ in. The camshaft is overhead and actuates the valves through rocker arms, the four for any one cylinder being inclosed by an aluminum plate that is individual for that particular set. Compensating springs are fitted to the valves so as to insure absolute following of the cams, even at very high speeds. Drive for the camshaft is attained by a vertical shaft at the front which is connected to camshaft and crankshaft by bevel gears, both upper and lower sets being completely housed with aluminum. The valve seats are cast in the aluminum cylinder block, and all four for one cylinder are in one piece—a new wrinkle, even for this newest of cylinder and valve constructions.

To insure the best possible cylinder casting the sides and ends of the waterjackets are open and aluminum plates are securely fastened to the openings to form the completed water space. Thus uniformity of the cooling area is attained at the same time and further lightness in the bargain.

Three ball bearings carry the crankshaft, and in order to get the center one in place the shaft is split into two parts securely bolted together by substantial steel bolts. The shaft is of large proportions with very large webs, so that vibration from this source should be almost nil. The pistons are of a special type that might be termed an umbrella form. The piston upper part, carrying two rings, extends down only a little over an inch and joins the portion containing the wristpin bosses through an extension of the inner center, and this part flares below the wristpin to make the lower skirt, which is drilled with holes to lighten it. Thus maximum cooling is attained with minimum weight and bearing surface.

Hollow steel connecting-rods of surprisingly light weight are also a part of these feather-weight cars. These are machined all over and balanced to a nicety that should be conducive of most excellent results. Four bolts hold each machined cap in place, and at the wristpin end there is provision for a steel pin to hold the wristpin in place and cause it to have its bearing in the bosses of the piston.

Special Oil Cooling

Chevrolet has given a great deal of thought to the oiling system and methods of cooling the lubricant. Directly in front of the dash is located a 12-gal. semicircular oil reservoir, the entire front of which is provided with copper cooling fins. The underpan of the engine and a metal shield below this tank completely trap the inrushing air that comes through the radiator and force it to pass over these fins in order to get out. Thus any air that enters the radiator must pass over the front of the oil tank before it can escape. This is really a forced-draft scheme and excellent results are expected from it. In connection with this tank arrangement two independent oil systems are fitted, so that should trouble

come to one the other will adequately take care of the requirements. Two gear pumps are driven by the magneto and water-pump shaft on the left. The oil is forced from the tank directly to the crankshaft bearings and some by-passes to the overhead camshaft at the front end. From the rear end of this unit the oil is led down to the oil sump at the bottom of the motor. From the crankshaft main bearings the oil is led through centrifugal rings on the shaft to the connecting-rod lower bearings, and the spray from these gets to the cylinder walls and wristpin bearings. In addition there is a pump at the mechanician's hand that forces oil directly from the tank to the bearings. One of the gear pumps takes its supply from the sump.

The motor is supported in the frame at four points on steel tubing and is entirely separate from the gearset, which is amidships on three points. This makes a very sturdy layout, allows the flywheel to be completely open, and reduces the weight. Drive is by the Hotchkiss method, using an open propeller shaft with two universals and semi-elliptic rear springs 45 in. long.

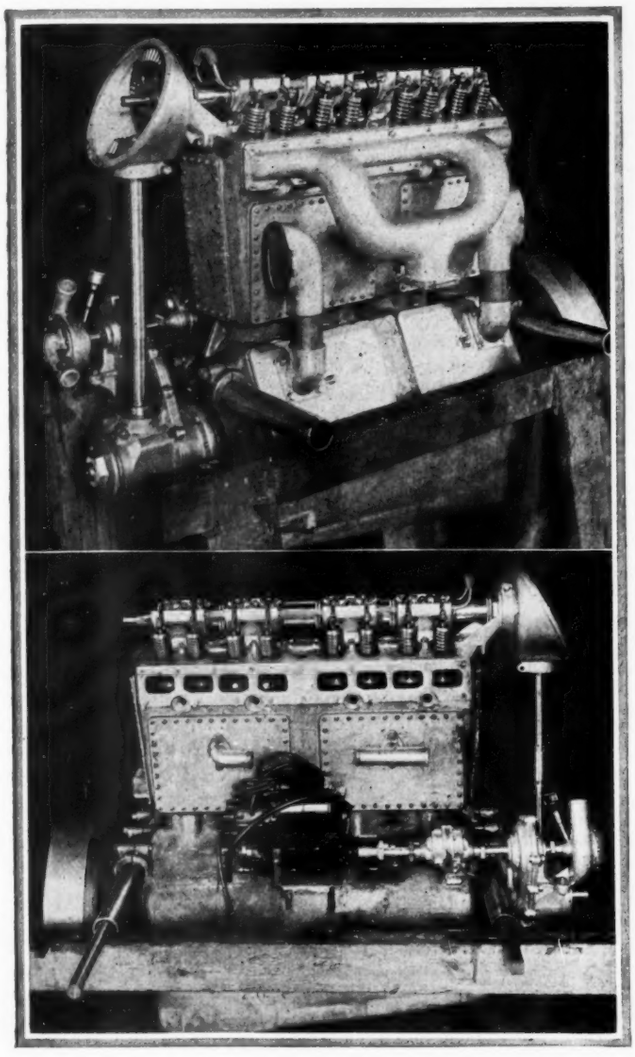
No differential is used in the axle, and Chevrolet has allowed himself some latitude in the matter of gear ratio. He has three sets of gears available for each car, these being 2¼ to 1, 2 1/3 to 1 and 2½ to 1. It depends upon the results obtained with each, when the cars are put on the track, to finally fix which will be employed in the races.

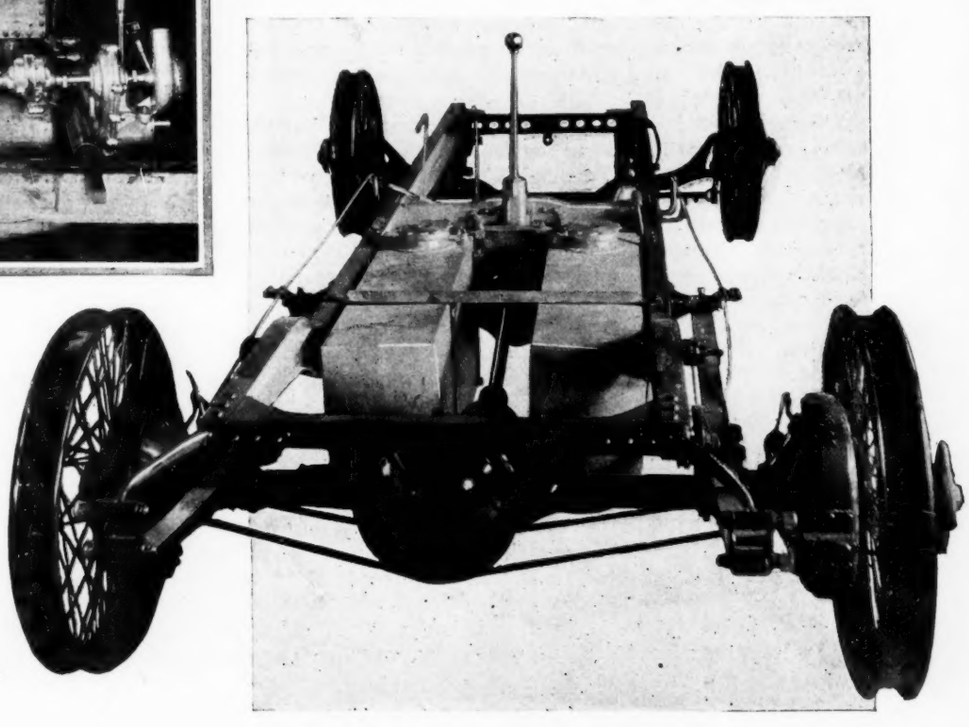
An unusual but very logical location has been given the gasoline tanks. Two long and narrow reservoirs are hung below the frame and alongside of the gearbox and driveshaft on either side. These will serve to distribute the weight and put more of it where it belongs, at the back end of the car, thus making it hold the track better at speed and undoubtedly affecting the pace at which the cars can take the turns. Putting this tank weight low, the center of gravity is brought down considerably. The piping is arranged so that either feeds the carbureter, and there are shut-off cocks from each running close to the mechanician's seat, with filler caps in the floor boards.

Chevrolet has undoubtedly designed a beautiful body. It has a graceful sweep and is shaped for the minimum of wind resistance, with a pointed tail, narrow radiator, and sloping without external obstructions to set up eddies. The curve of the underpan follows the same lines and makes the whole thing look like a big cigar. The wheelbase is 104 in.

Has Flexible Steering Wheel

One very clever feature of the cars is the flexible steering wheel, if it might be called such. In racing, the driver gets much of the jarring and vibration of the track, this being transmitted to his hands and wrists through the steering wheel. To absorb this continuous jarring, the arms of the steering wheel spider are made up of three thin plates that have somewhat the same action as a leaf spring. Thus the

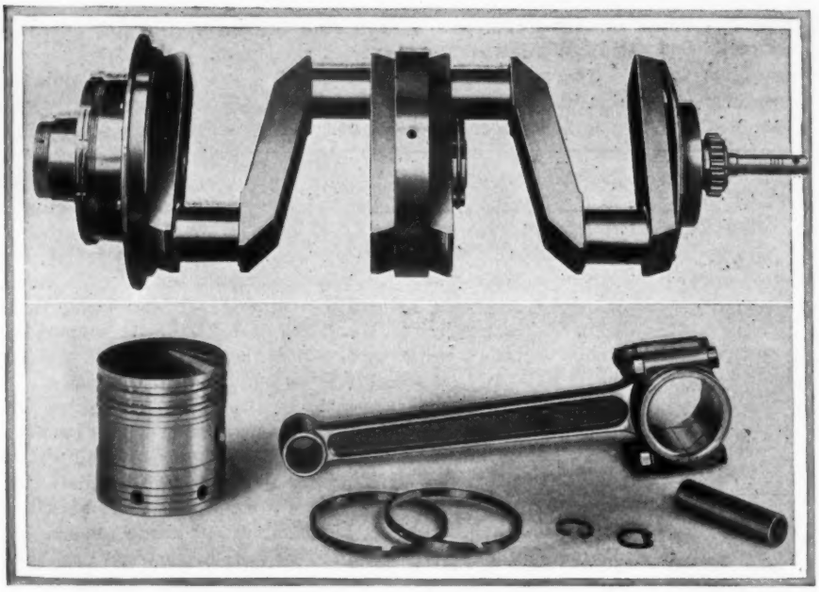




Above—Intake side of the aluminum engine in the Frontenacs. The water-jacket spaces are open, and covered by aluminum plates as seen. Note the aluminum breathers and bevel gear drive of the overhead camshaft by the vertical shaft at the front, the whole being inclosed

Below—Exhaust side of the aluminum Frontenac racing engine, having a bore of 870 by 6.375. There are four valves per cylinder

Right—View of the Frontenac chassis showing the disposition of the gasoline tanks on either side of the driveshaft and gearbox. This location brings the center of gravity down and distributes the weight better, insuring the car's hugging the track



Above—Two-piece crankshaft used in the new Premier racers. It is carried on four ball bearings, the rear bearing being double
Below—Piston and connecting-rod assembly of the new Premier racers. Although 2 lb. lighter than the Peugeot assembly, it is stated to be stronger

wheel can be moved a maximum of 1 in. up or down from its normal plane, and this ability to absorb shocks should result in less tiring of the driver's arms and wrists.

Some of the accessories and parts that have been incorporated in these Frontenacs are Bosch magnetos, Zenith carbureters, Rudge-Whitworth wire wheels, Gemmer steering gears, Goodrich Silvertown cord tires and K. L. G. air-cooled spark plugs.

The new Premier cars, of which there are three, have been built especially for this race. They have never yet been run even on the road, and will not be on the track for 2 or 3 days. The first week in February there was not even a drawing of the new cars in existence and, considering the time and the extraordinarily hard task of getting materials of a special nature through any of the war-order-crowded plants, an extraordinary amount of progress has been made. Two of the cars will be driven by Anderson and Rooney of Stutz fame and are about a day apart in construction, Anderson's car being in the lead in this respect. The third car will be piloted by Stillman.

The cars were designed by James L. Yarian, who has the title of engineer of the racing car department of the Premier Motor Corporation. In 3½ months the drawings have been worked out, the steel, which has all been ordered to special analysis, secured, the connecting-rods, crankshafts and various parts cut from solid billets of steel, and even the frames hand-made because the rolled sections could not be secured in the stock desired.

The design is a composite one, smacking somewhat of Peugeot, a little of Delage, and also with a suggestion of the Mercedes. The four cylinders are block-cast and have a bore of 3.66 and a stroke of 6.625 in., giving a displacement of 235 cu. in. The cylinder casting is probably one of the most complex ever made, as the waterjacket is only a sheet of metal 3/16 in. thick and does not touch the cylinders at any point except the top and bottom throughout the entire length of the casting.

Sixteen valves are used, and these are placed overhead, being driven by two overhead camshafts contained in separate aluminum housings. The intake valves are 1 15/16 in. and the exhaust 1 9/16 in., and each has a lift of ⅜ in. The valves are, like most of the other working parts throughout the car, of special steel, analysis and heat-treating specifications being the results of experiments by the designer.

The timing gears are pinned to the front end of the camshaft with a different number of holes in the gear and flange, thus giving a vernier style of adjustment. The camshaft is hollow and is carried on five bearings. The hollow through the camshaft acts as an oil lead, as will be described later.

Double springs are used on each valve, and there is provision made, by means of an enlarged section, to guard against the possibility of the valve dropping down into the cylinder in case of breakage. It takes a pressure of 150 lb. to operate the valve ⅜ in. against the spring pressure, which should be sufficient to guard against riding, even at the highest speeds.

No clearance adjustment is provided at the ends of the valve stems. The manner in which the adjustment is made is through the means of buttons. The valve tappets are hollow and in the ends of the tappets are inserted buttons which have a neck of sufficient length to guard against their falling out. The button nearest the proper size is selected and then filed to the correct clearance.

Although the reciprocating weights of the new motors are 2 lb. less than those of the Peugeots, the connecting-rods are stronger at the upper ends, the point where the rods in the Peugeot cars have failed once or twice. This result has been accomplished by using a differently shaped flange and a deeper web, although the basic I-beam section has still been maintained. The pistons are rendered stronger by the use of a supporting piece which is of cylindrical form, extending from the center of the piston head to the upper side of the wristpin.

The connecting-rod is cut away at the top of the wristpin and the aluminum supporting piece rests against the upper side of the wristpin with a bearing fit. This gives a solid column of support from the center of the top of the piston straight down to the lower connecting-rod bearing, through the support piece, the wristpin and connecting-rod.

Oiling Very Thorough

The oiling system has been particularly well worked out. The oil supply is carried under the seat, and amounts to 7 gal. It is fed to the crankcase under pressure, and then distributed by the force feed pump through five independent leads. Four of these are to the main bearings and the other enters the hollow camshaft at the rear and passes through it in a thick stream. There are leads drilled to each of the five camshaft bearings, and the shaft itself runs submerged in oil. The oil then passes out the front end of the camshaft and through a lead to the timing gears, which are supplied very liberally. A lead is also taken off to the water pump and magneto shaft bearing, the oil then passing back to the crankcase for recirculation.

The crankshaft is in two pieces and is carried on four ball bearings. The rear bearing is double, giving two single bearings for front and center.

The motor is mounted in a subframe which also contains the gearset. The subframe is mounted flexibly at three points, the front support being a single trunnion in the center of the cross-member, and the rear supports are ball and socket connections back of the gearbox, which is amidships.

Ball bearings are used throughout the three-speed gearset, the main gearset shaft extending through the driven member

of the clutch and being connected to it by a squared section. The end of this shaft rests in the center of the flywheel. This fixes the alignment of the motor and gearset, and the whole flexible subframe could be swung as much as a foot out of line without affecting the drive.

Hotchkiss drive is used and a ratio of about three to one, with 35-in. wheels, will probably be fixed upon, although this is not certain as yet. The axle housings are swaged from solid steel tube under 40 tons' pressure.

All of the center housing of the differential is of aluminum, and the bearings used throughout the rear axle are ball. In fact, this type of bearing has been used liberally even for a racing machine. Each of the timing gears, for instance, has two ball bearings, and the pressure of a finger is sufficient to rotate the entire set.

A neat feature in the chassis is in the clutch. The cone is of steel, and behind it there is a fiber-to-steel clutch brake, the fiber being between two steel disks. Every detail of the car is special, and the only stock parts are the wheels and shock absorbers. The springs are semi-elliptic all around and the wheelbase is 106 in.

The magnetos used are Bosch, and the carbureters are Zeniths, with special ball bearing throttle connections.

Seven gallons of water are carried in the radiator, jackets and connections. The radiator is a square tube type made especially for this car by Fedders. It has a false front made up of a removable screen placed 3 in. in front of the radiator proper. The pump, being on the same shaft as the magneto, runs at magneto speed and is of the impeller type.

Gasoline is carried in a tank located in the aluminum tailpiece. The tank capacity is 29 gal., and it is calculated that, as the consumption will be a little better than 11 miles per gallon, the car will go through the race, if need be, without renewing the supply.

A Summary of Entries

The Peugeot to be driven by Charles Merz will have the motor as described and the old Grand Prix Peugeot chassis stiffened up and revamped by the Premier company.

The new Premier cars will be purchased by the Indianapolis Speedway Corporation and will be raced by them, with Anderson, Rooney and Stillman as drivers. These men are now working at the Mais plant on the cars.

Of the thirty cars entered for the Indianapolis race on Decoration Day, there are but two entirely new in every detail, these being the Premiers and the Frontenacs, already described. There are a few of which very little is known, the DuChesneau, the Richard, the Ogren and the Osteweg, had not appeared on the speedway at the time of writing, and no information concerning them has been given out. The two Maxwells which were described in THE AUTOMOBILE for May 11 are the same cars which competed in the speedway events last year, improved in detail during the winter by sundry small alterations.

The Peugeots are of the same type and have been subjected to various degrees of reconstruction. Parts which proved weak toward the end of the racing season of 1915 have been replaced. To take one instance, those belonging to the Indianapolis Motor Speedway Corp. have had fitted new connecting-rods of a slightly different section to the original Peugeot rod.

The Sunbeams are the same chassis which were competing last year, but instead of four-cylinder motors the engines now have six cylinders. The general design is almost exactly the same as that of the Peugeot.

The Duesenbergs have both of them sixteen-valve four-cylinder engines, but otherwise are similar to last year's cars. The general design of the engines with their horizontal valves is very much like the older pattern. Characteristic of the Duesenberg motor is the complete inclosure of all the valve mechanism, the appearance of the finished job being that of a rectangular metal box. The Crawfords also have Duesenberg motors.

The New Duesenbergs

The three new Duesenbergs which are being completed in the new quarters at Chicago look to be much speedier than any mount O'Donnell has had. Not only have they the sixteen valves which featured the new motor of last year, but the very light tubular connecting-rods and extraordinarily sturdy crankshaft make the new motors very powerful. In addition the cars are considerably lighter and will scale close to 1800 lb. The characteristic turtle back has given way to a pointed tail and a pointed nose is fitted.

There are two types of Delage, those driven by LeCain and Devigne being the 1914 Grand Prix cars described in THE AUTOMOBILE for March 23 and again briefly mentioned on May 11.

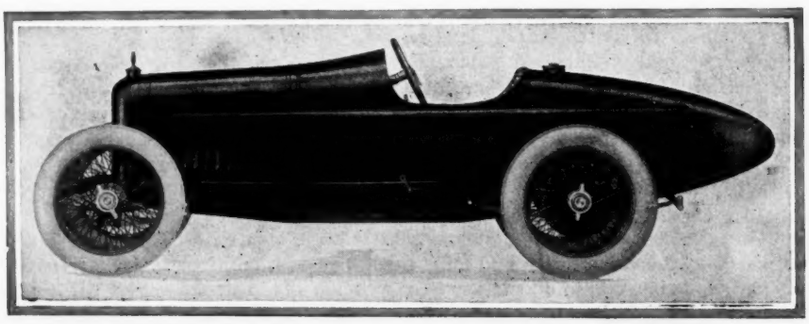
Oldfield has an earlier type with horizontal valves which is understood to be practically the same as last year.

The Erwins are special jobs with L-head engines, these being arranged with exhaust valves in the usual position, and overhead intake valves operated by pushrods and rockers.

There are two noticeable absentees: of these the most prominent is Ralph De Palma, who won the event last year, and it is also a disappointment that no Mercer team is to appear since this was rumored as possible some months ago. De Palma has been rebuilding the engine of his Mercedes and has had considerable difficulty in replacing the original parts since he can get nothing whatever from Germany.

The first International race at Indianapolis in 1911 was won by Ray Harroun in a Marmon, 74.59 m.p.h.; Joe Dawson in a National won in 1912, averge 78.70 m.p.h.; Jules Goux's Peugeot won in 1913, average 75.92 m.p.h., falling short of Dawson's speed. René Thomas in a Delage won in 1914, averaging 82.47 m.p.h. Last year DePalma and Dario Resta fought it out, with DePalma emerging victorious, with an average of 89.84 m.p.h. Goux and Thomas are fighting for France in the European war and can not race this year.

With the distance this year cut down to 300 instead of 500 miles, the contestants will go faster from the start and maintain a faster average all the way, it is believed, because they are saving 200 miles' wear on their cars. The Indianapolis speedway, which was the first in America, offers a thrilling race because the human equation plays such an important part. The track, being a brick paved oval 2½ miles around, has four high banked curves and two long straightaways. To encircle the track once a driver must change the position of his car eight times. At board tracks where the cars get in a saucer and stay there automatically, the driver's skill is not called into play so much as at Indianapolis, where every second may make a winner out of a trailer. Every race at Indianapolis has been full of exciting changes.



One of the team of three special Premier racers for the Indianapolis race

Power Lies in Valve Proportions

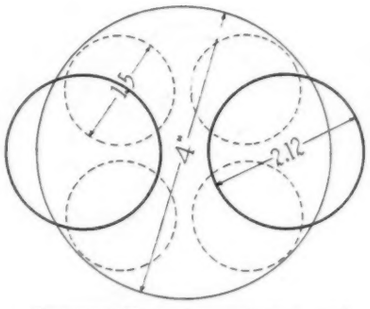
Difference Between Old and New Racing Cars Mainly Found in Valve Opening—Need for Large Valve Areas Controls Design

By A. Ludlow Clayden

TO SAY that the engineer responsible for a modern racing engine first designs his valve gear and then fits the rest of the engine to it is hardly too strong a statement. There is but one limitation imposed that is outside the control of the engineer, this being the 300 cu. in. piston displacement. Every two revolutions the engine may burn 300 cu. in. of gas if the designer can manage to persuade this amount to enter the cylinders.

Now the total power that can be developed by a gasoline engine depends upon the amount of gas it can burn, since each cubic foot of good mixture contains just about the same amount of heat. Therefore the engineer wants to get as many revolutions as possible per minute together with the largest possible percentage of charge into the cylinder on each suction stroke. It is no good to increase the speed if the valve area restricts the amount of gas that can pass in a given time. All other things being equal, the larger the valve area the faster can the engine be run without wire-drawing the charge, and this is why racing motor valves are the most important part of the design.

There is one other limitation in actual fact, as well as the 300 cu. in., this being the volume of the combustion space. To get the best compression ratio the total volume of the charge when compressed must not exceed about one-fifth of its uncompressed volume, which means that the total area into which valves can be put is definitely limited.



Corresponding sizes of two and four valves of equivalent area

Timing Not Important

To say that the timing of a racing engine is not important is almost a heresy, and the statement will no doubt be laughed at by many racing men, but it is none the less true. Given a certain engine, its power output may be varied considerably by altering the timing, but starting from the drafting board it is possible to lay out a variety of designs requiring different timing to give the best results. There is no secret timing applicable to all motors which always gives the best effects.

Let us look at the ideal timing. On the suction stroke the ideal is to have the biggest possible opening uncovered completely in no time at all at the top dead center and closed, also in no time at all, at the bottom dead center. For the exhaust stroke the ideal would be to take off the whole top of the cylinder *instantly* at the bottom dead center and put it on again at the top center. All valve gear and all timing is a compromise which gives some sort of approach to this ideal.

The intake valve timing to get the best effect is probably the most troublesome. Firstly, there is some exhaust pressure left in the cylinder at the closing of the exhaust valve, so the suction cannot begin till the piston is a little way down on its stroke. But the valve takes, and *must* take, a perceptible time to open; so it is usual to start the opening earlier in the stroke than real strong suction can begin. Suppose the intake valve opens at dead center, then no gas will pass through it till the piston has gone down an inch or so. As soon as the piston has descended enough to counteract the effect of the exhaust pressure left in the cylinder after the closing of the exhaust valve, the intake valve will be well open and ready to allow the suction to act strongly on the carbureter.

Therefore we have two courses open. One is to make the intake valve open quickly and start the opening late, 5 or 10 deg. after the top dead center, say. The other is to open the valve slowly, and commence the opening very early, even before the top dead center is reached on the exhaust stroke. Should the exhaust valve also be open at this time, only closing *after* the top dead center is passed, the exhaust will continue to travel out through the exhaust valve and little or none will be driven back through the intake valve into the carbureter manifold. This is called overlapping timing.

The intake valve will only be open a very small amount before the exhaust valve closes. Thus, the more rapid-acting the cam is, the later the valve can start to open, and the earlier it may close. So the problem before the engineer is to choose a happy mean. There are limits to the possible rapidity of valve movement, owing to the considerable force needed to open and close a valve in tiny fractions of a second, wherefore many designers prefer to use a slower opening and closing with a more widely spread timing.

Up to 1912 most of the European racing engines had the conventional two valves per cylinder, but that year and in the years following two-valve construction gave way to the four-valve design now most usual. This is not so much because four valves can provide a greater *total* area than two, but because four light, small valves can be opened and closed more rapidly than two of equivalent area which are essentially much heavier.

The weight of a valve head varies roughly in proportion with its area, and the area varies with the square of the diameter. Since the small valve does not require the same thickness of head as the large one, the weight increases actually more rapidly than the diameter squared. With a doubled diameter the weight is multiplied by four and then increased again by a substantial addition to the thickness of the head.

Forces Acting on Valve

To appreciate the forces acting on a valve assume the crankshaft speed is 3000 r.p.m., which, of course, means 1500 r.p.m. for the camshaft. Suppose the inlet valve starts to open 10 deg. after top dead center and remains open 25 deg. after bottom dead center, then it will be open for a total angular movement of the camshaft of 105 deg. During the first part of the opening, the valve is being accelerated from its seat. It is then decelerated, pauses for a tiny fraction of time, accelerates toward its seat and finally decelerates till it comes to rest on the seat.

With our assumed timing the acceleration period lasts for about a quarter of 105 deg., namely 26.5 deg., during which travel it will have been lifted half its total lift. At 1500

r.p.m. of the camshaft the angular speed is 900 deg. per second, so the acceleration period for the valve is 0.00294 sec.

Suppose half the lift is 0.2 in. and the weight of the valve 4 oz., then the force necessary to produce the acceleration, neglecting the spring pressure and the weight of the tappet, is 15.5 lb. in round figures. Add the weight of the tappet and half the weight of the spring plus the spring pressure and it will be at least doubled.

Furthermore, the spring has to do just the same work during the first half of the closing movement of the valve that the cam has to do in the first half of opening movement, thus a four-ounce valve if it is to follow the cam accurately at 3000 r.p.m. of the crankshaft may easily need a spring of considerable power.

Now assume the valve is double the diameter, which means four times the weight and more. Take the weight as being just 1 lb. and the force required increases to 62 lb., considering only the valve and neglecting the tappet, etc. Add the other masses and a spring giving a pressure of 120 lb. or so is the least that will be required.

Suppose the bore and stroke are 4 in. by 5 in., which is about right for a 300 cu. in. four-cylinder engine; and suppose that we allow a mean velocity of 200 ft. per second through the inlet valve, which is a normal velocity, then the area of inlet opening needed is approximately 3.15 sq. in. Allowing for the fact that the valve cannot be fully open for more than a small part of its period, we shall need at least 3.5 sq. in. of valve area.

Four Valves Need Half Spring Strength

Now a single valve of 3.5 sq. in. area will be 2.12 in. in diameter. Two valves to have the same total area, 3.5 sq. in., will have to be a shade under 1.5 in. in diameter each. The strength of spring required will be in proportion to the diameters squared as explained before, namely in the proportion 449 to 225, which means that the pressure throughout the valve mechanism will only be half the amount for the small valve that is necessary for the large one.

There is still another advantage in the lighter units. A very strong spring needs heavy wire and the rapidity of spring action is dependent upon the section to some extent. A heavy spring is bad, first, because of its weight, and second, because it is more sluggish in action than a spring of lighter section. Incidentally, it has been found that where a spring pressure of 80 lb. is required, faster action may be obtained by using two 40-lb. springs, one within the other, than by employing one spring of full 80-lb. strength.

The arguments applying to the inlet valves also apply to the exhausts, of course, though the need for size is a trifle less important.

Compactness a Feature

Taking another aspect of the case; suppose we start with a circle 4 in. in diameter and imagine this to be the top of the piston. On top of this draw two circles of 2.12 in. and also four circles each 1.5 in. This makes obvious the fact that two valves will necessitate a combustion head with a bulge on each side while the four valves will practically locate within the four-inch circle.

Instead of placing the valves with the stems vertical they are usually put at an angle of something near 45 deg. and this allows good water space all around each valve seat, while giving the necessary small combustion space. Also the combustion space thus becomes of a shape which approximates to a hemisphere, and that is the best shape from the viewpoint of thermal efficiency.

Many Arrangements Possible

There are many ways of arranging the four valves because, after the valves themselves have been designed, there remains the need for locating the parts to work them. Just as the weight of the valve is of paramount importance, so is the weight of the tappet or rocker to operate the valve. The least weight of valve-operating mechanism is got by following the Peugeot school of design, in which there are two camshafts contained in aluminum housings, mounted directly over each row of valves so that the axis of the valve stem passes through the center of the cam. In this design the cam is separated from the valve stem by a very short distance, just enough to allow for a short push rod to connect the cam with the valve that will have a long enough bearing in the case to prevent too much oil leakage.

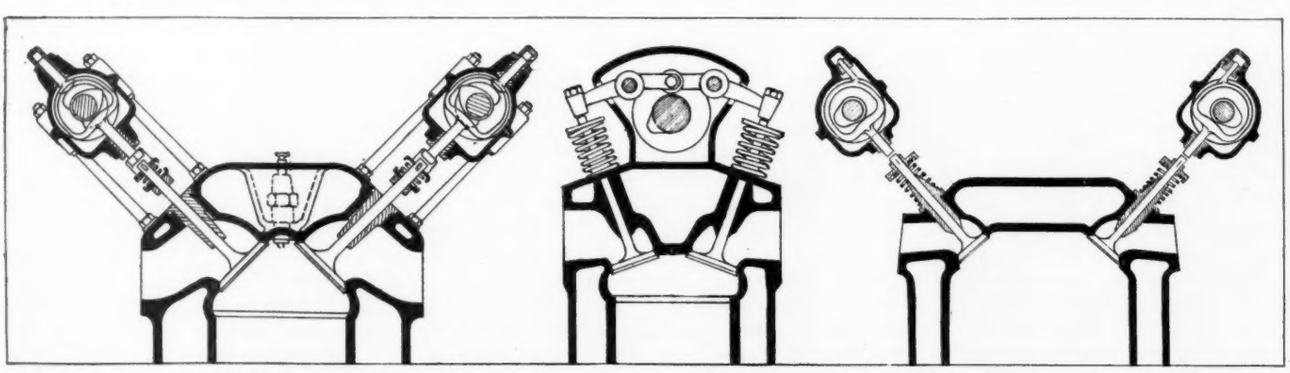
The drawback to this design is that the two camshafts with their necessary driving gears make for complication and, though the valve parts are kept low in weight, the total mass of the two camshafts, etc., is a consideration.

Rockers Give Same Results

Alternatively there is the older design developed by many different manufacturers of using one overhead camshaft placed centrally over the cylinders, the straight tappet rods of the Peugeot type being replaced by small rockers. This cuts down the complication and reduces the total weight, but the rockers are almost impossible to make so that their reciprocating mass is as small as the little push rod in the Peugeot. Results, however, show that practically the same power output is obtainable with either design. Prominent users of the rocker construction are Mercedes and Stutz-Wisconsin.

The old design where the camshaft was in the usual place in the crankcase and the valves operated by long push rods is impossible for racing to-day, as the long rods cannot be made light enough. It has been suggested that the action could be reversed and pull wires substituted for push rods, but the idea has never been tried and does not sound very promising.

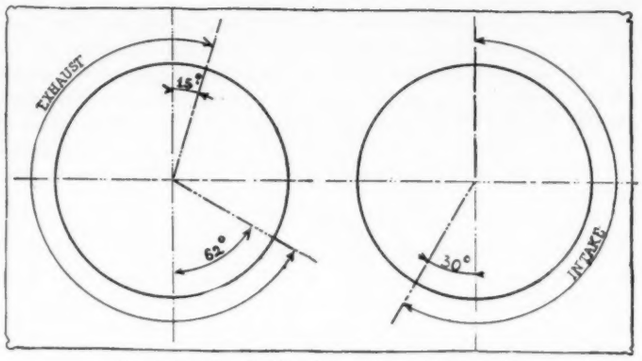
Another school of design, which differs in detail though not in principle, is exemplified by the Duesenberg and the old Delage engines. Here the four valves are used just the



Left—The unique Delage mechanism whereby the cam closes the valve as well as opening it. Center—The Mercedes type of design with a single camshaft and rocker arms. Right—The Peugeot design, which is really the basis of all modern overhead valve engines

same, but they are not set at 45 deg. in the head; instead they have the stems horizontal and open into a high, narrow combustion head, rather like the usual combustion space stood on end. For operating the valves there is a camshaft on each side of the crankcase and, in the Duesenberg motors, long rockers, set vertically, connect the cams with the ends of the valve stems. The old Delage had a different scheme. There were two camshafts in the crankcase, each operating four long push rods. On either side of the cylinder block was a rocker shaft, placed above the valves and running from end to end. On this shaft were rockers with three arms, of which one was lifted by the push rod while the other two pressed on the valve stems. Delage has since abandoned this design because the reciprocating weight of the push rods and rockers was too great, and the older Delage cars are therefore a sort of half step between the L head motor and the Peugeot type of overhead valve construction.

Though it has been described many times, the new Delage system cannot very well be omitted from a review of this character. Externally the present Delage racing engine looks very much like a Peugeot and the difference is all within the camshaft case. Each cam is surrounded by a stirrup, the cam pressing on one side to open the valve and on the other to close it, the stirrup being attached to the end of the valve stem through the medium of a very small but stiff spring which is in slight tension when the valve is shut. The idea is to eliminate the lag of the spring altogether and to shut the valve just as positively as it is opened, eliminating all lag.



Typical valve timing for a four-valve engine

The theory underlying the four-valve engine with overhead camshaft has been known and appreciated for very many years, and the reason why it is only recently that four-valve motors have been made is that the older racing cars gave so much trouble with other parts of the engine that the extra volumetric efficiency given by the four valves could not have been utilized without breaking up the rest of the motor. At present there is nothing in view that appears likely to displace the four-valve type after the fashion in which it has displaced the two-valve.

Boillot Killed in Aeroplane Battle

Race Driver, Attacked by Five German Flyers, Brings Down One

PARIS, FRANCE, May 21—Georges Boillot, winner of the French Grand Prix of 1912 and 1913, has been killed in a fight with five German aeroplanes, near Verdun, after bringing down one of the German machines before a bullet pierced his heart. Boillot, a second lieutenant, brought down his first German aeroplane on March 31, in Haute-Alsace and later won the cross of the Legion of Honor. He was 52 years old.

Georges Boillot, racing pilot, killed in battle

At the outbreak of the war he joined the Automobile Corps, and using his Grand Prix racing car, carried out many dangerous missions as driver for General Joffre. Later he entered the aviation service.

Boillot's first and only appearance in a race in the United States was on the Indianapolis Speedway, May 30, 1914, where he broke the 350-mile record, his time being 4:15:22.69. He was forced to drop out in the 352.5 mile, the next lap on account of a broken frame, finishing fourteenth in the race.

Boillot in a Peugeot will be remembered for his victory in the 1912 French Grand Prix when he won out after a struggle with the late David Bruce-Brown. In the 1913 event on the Amiens course, he dashed over the 569-mile course at the rate of more than 72 m.p.h., winning after a hard struggle with Goux in a Peugeot second.

Boillot gained renown throughout the French army as General Joffre's driver. His eagerness to gratify the General's desire for haste led him to take unnecessary risks. After one particularly narrow escape General Joffre announced his intention to make a change of drivers, not so much because of the danger to which he was subjected as because Boillot's daring swerves kept him awake. The General liked to sleep during his 100-mile dashes along the battle front. Boillot accordingly went to the aviation corps.

He was the airman who performed the service described in a recent official communication, as follows: "One of our pilots, in the course of a stirring flight, brought down an aviator, which fell between our lines at Suippes." It was nearly a week before the world learned that it was Georges Boillot who had accomplished this feat. At one time he was surrounded by a regiment of German soldiers, and escaped death by riding through them at high speed.

Georges Boillot was one of those rare beings who combine great engineering skill with a master hand at the wheel. He was the idol of the French racing fans and on practice mornings before a great race the crowds of villagers who always turn out in the chill gray of the morning, used invariably to cheer their favorite to the echo. Watching from a turn in the road, one could always hear the murmur of voices heralding the approach of the blue Peugeot even before the roar of its exhaust was audible.

Boillot was a personality which earned him friends everywhere and also gained for him universal respect. Strong both in mind and body, he had a vigor and vitality which permeated the whole atmosphere around him. When the next French Grand Prix takes place there will be no face worse missed and his absence will be keenly felt.

Ignition Most Reliable Part of Car

Proper Mechanical Layout of Ignition Gear Prevents Electrical Troubles — Two-Point Ignition Preferred for Racing—Four Valves Render Plug Accommodation Difficult

IT is commonly believed that in the two-spark magneto the spark at each one of the plugs is weakened by the fact that two instead of one have to be supplied. This is not true, as the electrical characteristics involved by the ratio of the high-tension to the low-tension winding are entirely different in the two instruments. In other words the two-spark magneto is not simply a single instrument with a double-distributer but, on the other hand, is primarily a different design, electrically as well as mechanically.

Mechanical Difficulties

It is in the mechanical side of the ignition system for racing cars that the greatest difficulties enter. Broadly speaking, there is no such thing as electrical trouble. Given the proper mechanical conditions and electricity will not fail to do its part. The high temperature at the spark plugs furnishes a good example of this. In operating the motor at the temperatures obtained in racing, the insulation and the electrodes are submitted to stresses that would never be reached under other conditions. The consequence is that in the long races we see plug failures.

Keeping Plugs Cool

There is only one way to keep the plugs cool and that is by proper waterjacketing. At the same time the wall supporting the screwed connection of the plug must be firm enough to endure the wedge action necessary in tightening the plug. This has been worked out in the cars of this year much better than in the past, and at the Sheepshead Bay track plug changes were very scarce. In the 300-mile event at Indianapolis there may be more of them on account of the greater distance. Nevertheless the troubles as a whole have been greatly reduced.

The difficulty in getting material has hampered the plug makers to a great degree. The Bosch company had its last plug stand at the Sheepshead Bay race. Owing to the fact that this concern can no longer secure the Steatite used in the insulation of its plugs further manufacture has had to await changes in conditions.

Four Sparks per Cylinder

One of the interesting ignition systems of the year from a mechanical standpoint is that used on Christiaens' Sunbeam. This is a six-cylinder car and ordinarily a magneto used with it would have to be driven at one and one-half engine speed in order to produce the three sparks per revolution necessary with the four-cycle, six-cylinder engine. The magneto on Christiaens' car produces four sparks per revolution and hence is driven at three-quarter engine speed.

This reduction of the armature shaft speed of the magneto by using a type which produces four sparks to the revolution is important in high-speed work. If the magneto is driven at a greater speed than that of the crankshaft it becomes the fastest moving part on the car. The armature shaft bearings are stressed to a much higher degree, not only due to the higher rate of travel, but also by the thrust of the step-up gearing. The result is that the bearing life on the armature shaft is apt to be shortened. This same effect has shown itself to be true on lighting generator shafts on passenger cars where they were operated at a higher speed than the crankshaft and is due to precisely the same causes.

The care in detail work on the ignition systems is even better now than ever before, although the ignition system has always been carefully watched on racing cars. The improvement is in the better location of the wires and the precaution against chafing or breaking. This is not as yet perfect, however, and there are some cars in which the wires are not as neatly tied down as they might be. That accidents can happen to even such things as high-tension leads to the plugs is shown by the fact that Eddie Rickenbacher had to stop in the Sheepshead Bay event on account of a broken lead.

Quick ignition being necessary, a large proportion of machines are using two-point ignition. It has been said that this phase is falling off, but if it is so, it is because combustion chambers themselves are now of more highly-concentrated volume, allowing a single spark to do the work much more rapidly than before and also, incidentally, four valves reduce the space permitted for plugs to such a degree that it is often only possible to fit one. In the Sheepshead Bay race, of the eighteen cars to start, seven were fitted with two-point ignition and the others with single plugs.

A Battery System's Performance

The hot spark at high speeds, which is the greatly-desired feature in racing, falls in well with the characteristics of the magneto; hence this has been supreme for the past few years. One exception has been noted, however, this year in which the battery-equipped Hudson went through to third position in the New York event without showing ignition trouble of any kind during the run.

Taken altogether, racing ignition has not changed in any material respect, but throughout the entire system there is a greater reliability. Plugs are lasting better because they are better cooled. Broken wires are fewer because they are fastened much more carefully and such things as broken magneto straps, etc., which used to be responsible for putting good cars out of a race, have been reduced until it can really be said that in the racing cars for the 1916 season the ignition is one of the most reliable parts of the car.

Statistics of Stops in Previous Indianapolis Races

	1912	1913	1914	1915
Number starters	24	27	30	22
Number finished	10	10	13	11
Per cent finished	42%	37%	43%	50%
Troubles Classified by Source				
Steering gear	..	2	..	1
Valves	4	2	3	3
Ignition	7	..	1	4
Connecting rods	5	..	2	2
Brake adjustments	1	..	..	1
Gasoline leaks	4	3	..	1
Water circulation	1	..	..	1
Differentials	1	..	..	..
Piston rings	1	..	..	..
Broken wheels	1	..	1	..
Bearings	..	4	1	2
Clutches	..	4	..	1
Carbureters	..	4	..	1
Camshafts	..	1	1	..
Pistons	..	..	1	1
Crankshafts	..	..	1	..
Tires	90	88	138	96
Total stops	115	108	149	115

Automobiles and Trucks Break Mobilization Records

Aid in Assembling 10,000 Guardsmen in 2 Hr.

SHEEPSHEAD BAY MOTOR SPEEDWAY, May 21—Automobiles, armored cars and trucks played an important part in the mobilization of nearly 10,000 National Guardsmen for the opening of the military and naval tournament here to-day. Sixty civilian trucks and a number of passenger cars aided in transporting the men from the armories to the speedway.

A sham battle was held, the problem being the attack of a superior force on a smaller army covering the retreat of its main body. The coast artillery, Eighth and Ninth regiments, together with an armored battery, some engineers and signal corps men, defended one end of the inclosure and retired before the attacks of the infantry and field artillery units, aided by a troop of the First Cavalry. Sunday laws made the battle a silent one.

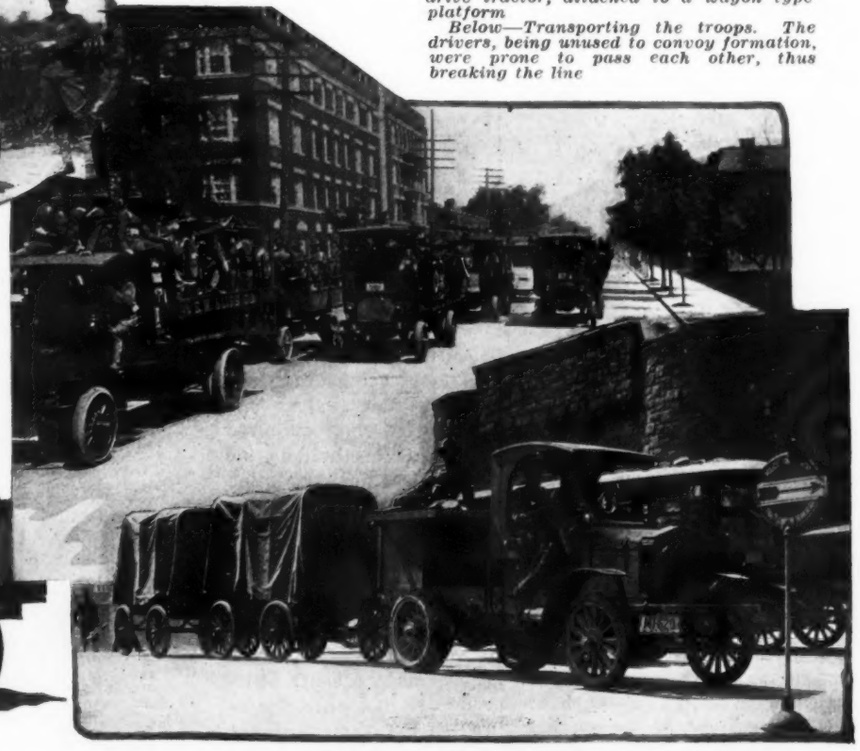
Attacking infantry advancing on the run across the speedway inclosure. Note the 2-ton Mack armored truck

Above—The Christie two-wheel, front-drive tractor, attached to a wagon type platform

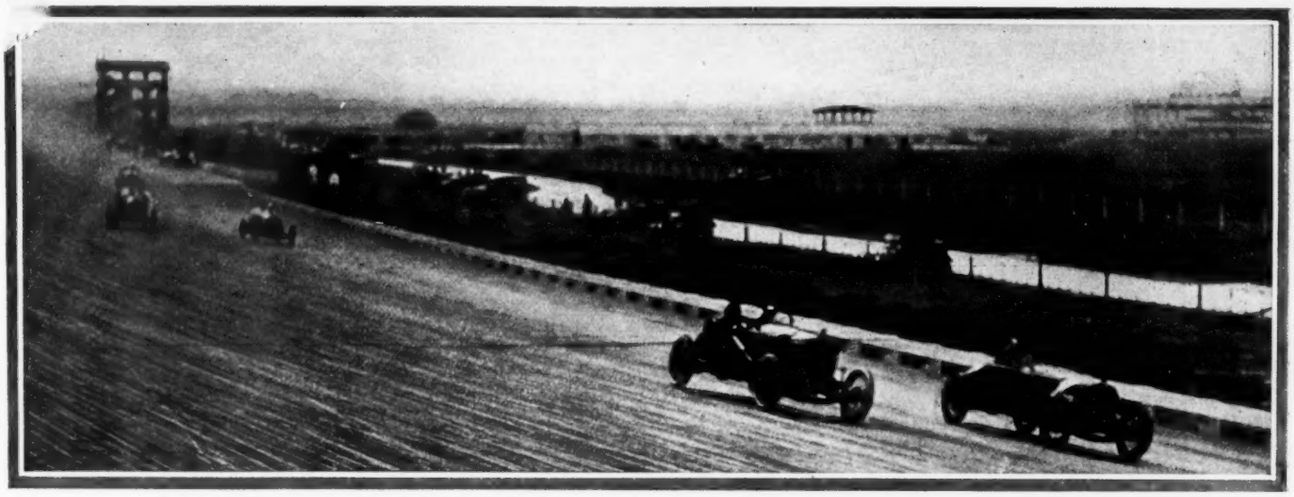
Below—Transporting the troops. The drivers, being unused to convoy formation, were prone to pass each other, thus breaking the line

Above—The 2-ton Mack armored truck, which was a feature of the maneuvers, proving a formidable machine for either offensive or defensive work

The Jeffery quad service wagon. Like the armored truck, illustrated above, this belongs to the First Motor Battery of the N. G. N. Y.



The new Pierce-Arrow 2-ton tractor towing two of the twelve 1-ton Trailmobile trailers which it is designed to haul. This tractor has a cruising radius of 670 miles, owing to its large gasoline tank, and is to carry two machine guns, which can shoot over the tops of the trailers, mounted on the platform



Start of the first heat of the amateurs' race at Chicago. This heat was won by W. A. Leet, who won the final

Mercer Winner in Amateur Race with 86.8 M.P.H.

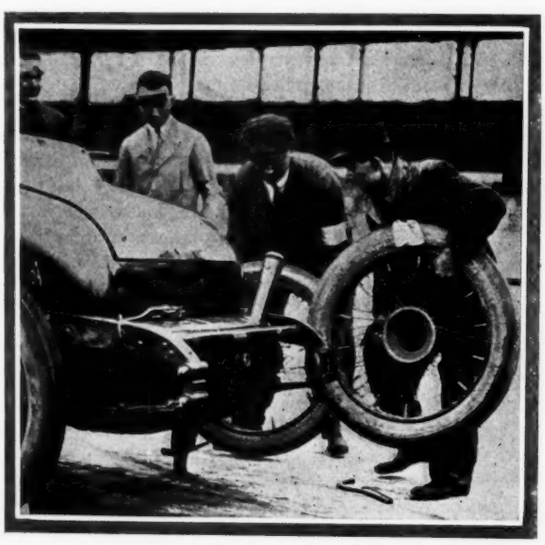
W. A. Leet Covers 30 Miles in Final in 20:44.4—Same Car Wins Dealers' Race

Left—W. A. Leet, who won the amateurs' race. Right—Dr. R. R. Duff, who made a lap at over 94 m.p.h.

CHICAGO, ILL., May 21—William Leet in his red Mercer ground out each of the 30 miles in the final dash of the Western Inter-Club trophy race in 41.4 sec., taking the honors and silver cup in the first amateur race ever held on an American speedway. Leet, who drove under the colors of the Omaha Club, completed 15 circuits of the board oval in 20:44.4, his average being 86.8 m.p.h. He was about one-half lap ahead of his nearest competitor, Frank Warren, representing the Speedway Park Assn., who drove his Cadillac across the tape 1 min. 4 sec. behind the winner, while William Robbins, representing the South Shore Country Club, in a Mercer, finished third, being 27 sec. behind Warren. Frank Book, entered in the name of the Detroit Athletic Club and driving a Cadillac, was fourth and F. C. Sawyer, representing the Chicago Athletic Assn., fifth, their times being 23:04 and 23:14.2 respectively. The preliminary heats were run yesterday.

William Robbins led the field up to the end of the third lap with Dr. R. R. Duff less than a car length behind, Duff jumping into the lead in the fourth, and holding it until the end of the sixth when Leet took first position and held it until the finish. Duff and Leet drove a neck and neck race until the end of the eleventh when the former was forced to retire with a broken oil pump.

However, Dr. Duff's Mercer won an honor not scheduled in the program. After taking the lead in the fourth lap he went into the fifth with a spurt that was clocked at 1:16.2, or a speed of better than 94 m.p.h., the fastest time ever made by an amateur on the Chicago track.



Changing a wheel on F. A. Sawyer's car

With Al Schillo at the wheel, the same Mercer with which Leet won the amateur event, showed the way to the six other entrants in the 50-mile dealers' race, maintaining practically the same speed as in the first race of the afternoon. Schillo's time for the half century was 34:35.1, and his speed 86.7 m.p.h. The Cadillac finished second in the dealers' race as well as in the amateur race with Count de Constant losing to Schillo by a margin of only 45 sec. A. W. Bromstedt in a Mercer took third after he had challenged Schillo for the lead for 40 of the 50 miles. On the Twenty-first lap Bromstedt threw a right front tire in the back stretch and came into the pits on the rim. He lost a lap in making the tire change and was unable to recover it.

The sympathy of the crowd seemed to be with Ed. Schillo, brother of the victor, as he drove under a self-imposed handicap of one lap, stopping at the pits on the paced lap. His Mercer finished fourth.

Factors in Universal Joint Design*

American and European Constructions Show Great Variety—Rules for Determining Size—Protection and Lubrication Most Important

By A. Ludlow Clayden

THERE is hardly a part in an automobile that has more work to do and yet has less attention than a universal joint. It is liable to neglect, alike from the user of the car and the engineer responsible for the chassis layout. Usually made by specialists, the quality of material and workmanship in the average universal is of a high order of merit, but a little more attention given to the disposition of universals and to means for maintaining their lubrication would result in a higher chassis efficiency and a very greatly enhanced durability. The way in which the user has become accustomed to poor durability of universals may be noticed by appreciating one's own natural expectation that a car which has run 10,000 miles will have a good deal of slack and rattle in the transmission. It is not always so, but it is so often, and seeing that this undesirable slackness is neither necessary nor impossible of cure, it really is somewhat remarkable that we accept it so calmly.

Universals Highly Efficient

When properly proportioned to the work they have to do, and when properly lubricated, few parts of a machine are more efficient than a universal joint. This was shown by demonstration in tests made on a well known joint in the laboratory of the Mechanical Engineering Department, of the University of Kansas and, as these tests have been published already, there is no need to repeat the report on them in detail. The most important thing brought out by the tests was that the efficiency of the joints was near to 99 per cent for angular deflections up to 7 or 8 deg. It was also shown that the efficiency fell off more and more rapidly as the angle increased, but unfortunately the largest angle for which determinations were made seems to have been about 15 deg. In any case, however, it is obvious that the loss of power in a well lubricated universal is so small that it can be neglected.

Velocity Variation More Serious

Where a single universal is used to connect two shafts at an angle, if the first shaft runs at a steady and regular speed, the second shaft will run at a speed which varies during each revolution between maxima and minima, the values of these depending upon the angle of deflection. The change in the velocity of the driven shaft is very rapid, as it occurs during each quarter revolution, there are two maxima and two minima during each complete turn of the shaft. For determining the amount of variation the formula is

$$V_1 = V \cos \alpha$$

and

$$V_2 = \frac{V}{\cos \alpha}$$

where V = angular velocity of the driving shaft, V_1 and V_2 = the maximum and minimum angular velocities of the driven shaft, and α = the angle of intersection of the produced axes of the shafts. (See Fig. 1).

Now, it is obvious that a variation in velocity of a propeller shaft in a car having one universal only cannot take place without some curious reactions. At one end we have the inertia of the whole car as a moving mass tending to keep the road wheel turning at a constant velocity, and at the other end there is the flywheel of the motor. Obviously we could not accelerate and retard the road wheel, and so the whole

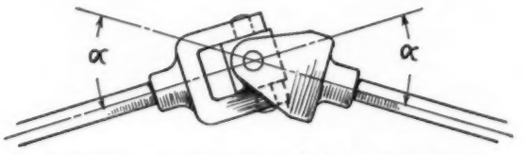


Fig. 1—Diagram to illustrate velocity ratio variation

car, twice during every revolution of the propeller shaft, even by a small amount, so it is to be assumed that the variation, which must take place somewhere, does so mainly on the flywheel.

Flywheel Fluctuations

Owing to the power of an internal combustion engine being made up from a series of explosions the flywheel has natural periodic fluctuations of its own and these will vary with the number of cylinders, the speed of the engine, the weight of the flywheel and the force of each explosion. With a four-cylinder motor the fluctuations would take place at the same rate as those due to the universal, in an eight at double that speed; so a four might have flywheel fluctuations that either coincided with or neutralized those due to the universal joint. That these fluctuations in speed are not so small that they can be neglected may be shown by quoting an actual value and, to take a low speed where variations have the greatest chance of being perceptible to the passengers in the car, we may assume a rate of revolution of 500 r.p.m. with

*Paper read at Cleveland section S. A. E. meeting, May 19.

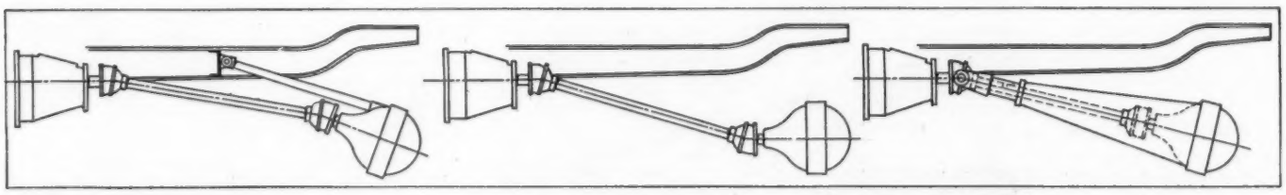


Fig. 2—Left—Layout for propeller shaft recommended by C. W. Spicer to divide angularity evenly between the two joints. Center—Layout obtained with Hotchkiss drive which bends both joints equally. Right—Layout with long torque rod which renders rear joint inoperative

an angular deflection of 10 deg. At 500 r.p.m. there will be 1000 maxima and 1000 minima of velocity in the propeller shaft which means 1000 vibrations per minute or about 17 per second. At the maximum positions the driving effort on the teeth of the bevels will be heavy, and at the minima it will be light, and an alteration in tooth pressure at so slow a rate of change as 17 per second would be distinctly perceptible in the form of vibration.

With a steady speed of the driving shaft of 500 r.p.m. and an angle of joint of 10 deg. the maximum velocity of the driven shaft would be 508 and the minimum 492 r.p.m. equal to a variation of 16 r.p.m. each quarter revolution. Now a quarter revolution at 500 r.p.m. takes 0.03 sec., an acceleration at the rate of 16 r.p.m. in this short space of time is rapid, so the load imposed on the bevel teeth is quite large. Practice shows clearly enough that cars with single universals are satisfactory enough, so the velocity variation is not serious, but it is probable that the elimination of the variation would render very smooth and effortless low speed running on high gear somewhat easier of attainment.

Two Ways of Eliminating Variations

There are two ways of eliminating the velocity variation, and both have been used successfully in practice. If we use two joints, one at each end of the propeller shaft, and if these make equal angles, the propeller shaft will vary in velocity owing to the angularity of the front joint, but the back joint will neutralize this and the bevel pinion shaft will run as steadily as the flywheel, any fluctuations of the speed of the crankshaft being reproduced faithfully on the pinion without reference to the universals.

The angle between the gearshaft, to which the front universal is attached, and the propeller shaft must be equal to that between the propeller shaft and the bevel pinion shaft, and this can be arranged either by keeping the bevel shaft always parallel to the gearshaft or by dividing the angular displacement between the two universals equally. If we adopt the latter style we gain the advantage that the angular displacement of either joint is only half what it would otherwise have been, and the efficiency is therefore better by some small amount. It is also unquestionable that the divided angle design is simpler to carry out than the parallel motion scheme, as the former can be secured by the use of a single, simple torque rod, while the latter requires regular parallel motion linkage of some complication.

It may be pointed out, however, that the so-called Hotchkiss drive, where the axle is locked rigidly to the springs, keeps the bevel shaft very nearly parallel to the ground at all times and so it is perhaps simpler, from this viewpoint, to use the parallel arrangement than the divided angle. The emphatic point is that the usual sort of torque rod which is anchored to the frame close to the front universal is not good, as it merely prevents the rear joint from doing its fair share of work, it prevents the second joint from damping out the velocity variation and it lowers the efficiency by throwing all the angular deflection upon the forward joint. Fig. 2 shows the three designs side by side for comparison.

Bearing Loads Are Heavy

However, the efficiency of joints is so high and the velocity variations of fairly small importance compared with the difficulty of lubricating the universals properly and their liability to wear and to rattle. Proper layout will minimize wear, but it does not help lubrication and does not prevent the creation of that slackness which produces noise.

Originally universals were very crude affairs and were both unprotected and unprovided with any means for lubrication, but of late years some very elaborate designs have been worked out, and there are just a few cars in which the universals can be trusted to last as long as any other part. The secret of durability is twofold; first the universal must be large enough for the load and, secondly, it must be bathed in lubricant continuously.

If the bearing surfaces are too small the torque of the motor will be able to squeeze out the lubricant and it must not be forgotten that the torque of modern motors is very high indeed. There is no need to go into detail examples, but calculation will show that among cars of all nations the bearing pressures in the universals when torque is at its maximum may vary from a few hundred to several thousand pounds.

The pressure on the bearings of a universal may be found by the following formula:

$$\text{Pressure per square inch} = \frac{HP \times 33{,}000 \times 12}{D \times \pi \times A \times R}$$

Where D = effective diameter of joint in inches, A = area in square inches of the two bearings carried by one fork and R = the minimum number of revolutions of the shaft at which the horsepower in question can be transmitted.

The allowable amount of pressure ought not, in the opinion of many engineers, to be allowed to exceed 1000 lb. per square inch at the maximum torque which the engine is able to apply no low gear. However, 2000 lb. is often permitted and even double this pressure, but the durability of the joints naturally suffers. A joint large enough to keep the maximum pressure below 1000 lb. per square inch is not cumbersomely big for passenger car use; it costs more than a smaller joint, but the extra outlay is well recouped in the better durability.

Just to consider an assumed extreme case take an engine developing 70 b. hp. at 2100 r.p.m. Assume the low gear in the gearset is 3 to 1 and we get:

$$12{,}600 = \mathrm{P} \times D \times A$$

Or, if P is 1000 lb. per square inch,

$$D \times A = 12.6$$

Thus if there are two pins each with an area of 1 sq. in., the mean diameter of the joint should be 6 in.; or 3 in. with pins twice the size.

These figures, rough as they may be, serve to show that the size of joint necessary to give a safe bearing pressure is not excessive.

Formula for Joint Size

It would be impossible to do more than guess at the safe maximum load, but the lower it is the longer the life of the joint, goes without saying; also the poorer the system of lubrication the lower should be the pressure. The fact that the joint does not revolve on its bearings, but merely oscillates slightly, makes lubrication more difficult and this fact must be allowed for.

A convenient form of the formula for determining the safe diameter for a universal, when the size of the pin bearings and the maximum pressure have been chosen, is:

$$D = \frac{HP}{R \times A} \times \frac{126.000}{P}$$

Or the same formula can, of course, be used to determine A when D is fixed by other considerations.

In America there have been such good universal joints made by specialists, that automobile engineers have given little attention to their design, but in Europe each automobile manufacturer makes his own joint, as this is a part of the chassis which has never been taken up by specialists with the solitary exception of the Timken representatives, who have shown some remarkable durability with a taper roller bearing construction. As a result, the European makers have been more concerned properly to protect and lubricate the universals, having nobody else upon whom to place the responsibility.

Lubrication Is Difficult Problem

When first the idea that a universal needed protection from mud arose, covers were made of leather. These were of little use, as the centrifugal force drove the grease through

every pore, straps broke and mud had a rotting action, so the cover was soon destroyed. The next step was to use a pressed brass cover and to close the mouth of the case with a smaller leather cover which, in this case, was just a plain cylinder. From this point development led to the use of a cover pressed or spun into a hemispherical form, the opening necessary to allow free movement to the shaft being closed by a corresponding pressed hemisphere held up by a coil spring outside the shaft. It is the last named type of covering that is in greatest use to-day and is very satisfactory indeed if made properly.

For lubrication all the different forms of case were supposed to be packed with grease, and grease is still the most common lubricant for universals. A well designed joint will contain enough grease to suffice for from 3000 to 5000 miles of running under ordinary conditions. There is one particular point to be kept in mind here, this being the effect of centrifugal action on the lubricant. If the outer case is very large the grease may all be thrown to the ends and the universal then runs in a cavity at the center where no grease touches it. Thus the case ought to fit fairly close to the joint. Next, the diameter of the case should be sufficiently greater than that of the hole through which the shaft protrudes to allow for the retention of a fair quantity of grease, supposing the piece which closes the hole to be removed.

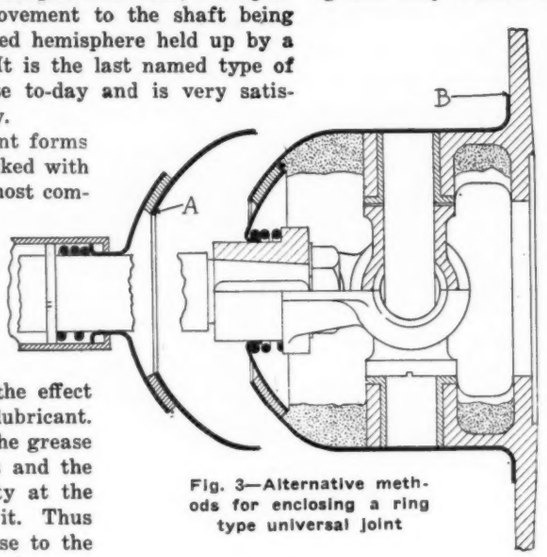


Fig. 3—Alternative methods for enclosing a ring type universal joint

If a joint casing is filled completely, centrifugal action will cause the middle part of the grease to be forced out through the joint between the case and the cover cap, however good the packing gland may be; the action is slow but sure. Thus the joint and case must be so proportioned and so arranged that the pins and their bushes are as close as possible to the outer circumference of the case and can be lubricated perfectly without the retention of grease at the very middle of the joint. In Fig. 3 is shown where the grease may reasonably be expected to remain. Even with these precautions in design the user should be careful not to use grease that is very hard because a certain amount of fluidity is needed to allow the lubricant to work its way into the pins.

Looking at Fig. 3 there might be reason to suppose that oil could be used, as there is no way for it to escape when the car is standing. However, most attempts to use oil have been disappointing because of the splashing that takes place. The usual way of arranging the cap is as shown at the left in Fig. 3. Presumably the oil is thrown against the inner surface of the cap, *A* Fig. 3, whence it is ejected past the packing. It seems thus that there are theoretical advantages to be claimed for inverting the usual arrangement and fitting the cap as shown on the right in Fig. 3, but even so it is to be doubted if oil would remain in the cover for long, and there would have to be some sort of a joint at *B* to allow the case to be assembled. This design has been used with success on several cars.

Experiments have been made with cases entirely independent of the joint itself and not revolving with it.

(To be continued)

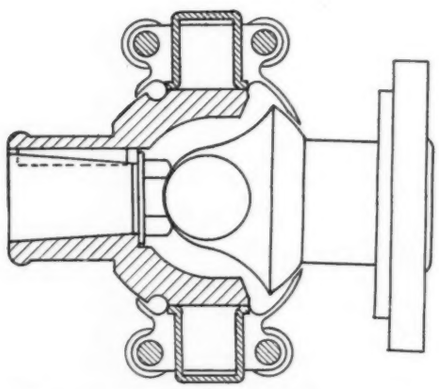


Fig. 7—Ring joint of the Wolseley car. A compact form in which the enclosure is obtained without additional case parts

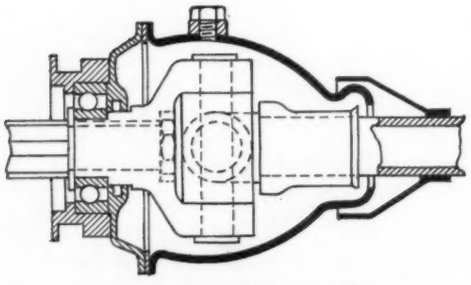


Fig. 9—Stationary cover used on a British chassis

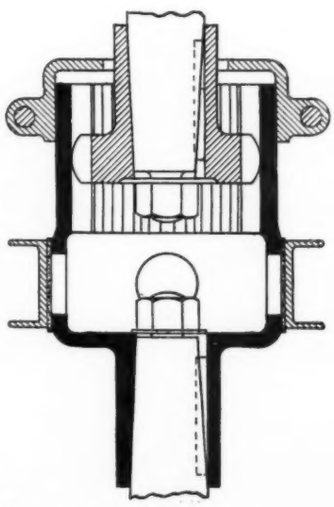


Fig. 4—Gear pinion telescopic joint used on some British commercial cars

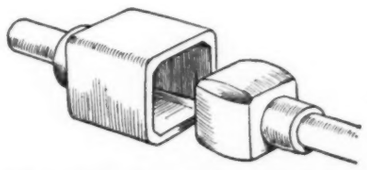


Fig. 5—The simplest possible combined universal and sliding joint, still used on the Lanchester car

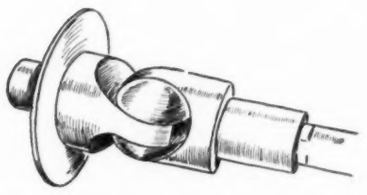


Fig. 6—Peculiar ball shaped universal used on British Rover cars

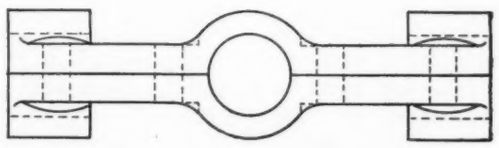
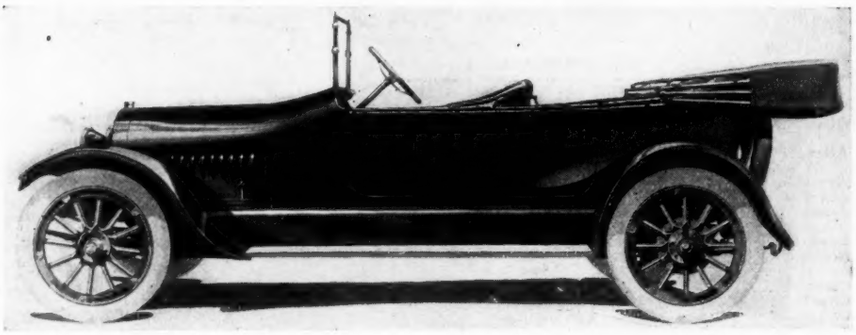


Fig. 8—Continental type of ring joint

Cloverleaf Roadster Features Crow Line

One Chassis with Two Bodies— New Electric System Employed



Side view of the Crow five-passenger touring car for the 1917 season

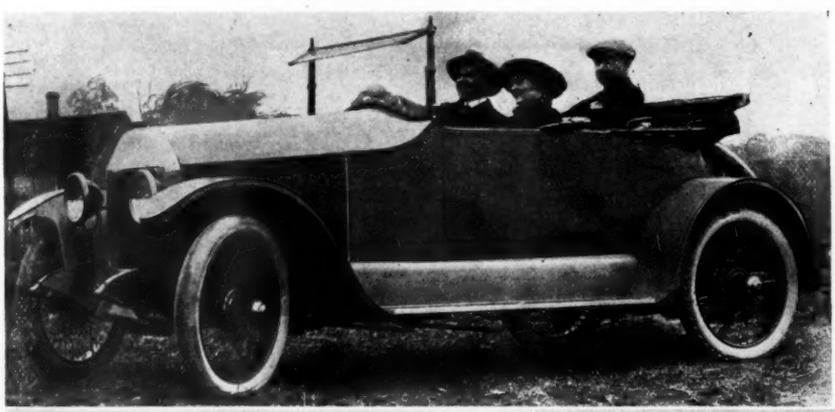
IN announcing the 1917 Crow cars, made by the Crow Motor Car Co., Elkhart, Ind., the important feature is the addition of a cloverleaf roadster, making two body models. Last year a coupé and sedan were listed but the cloverleaf is entirely new.

The five-passenger touring car has been improved in detail but still sells at $725 completely equipped, the cloverleaf selling for $795. Among the changes for this year is an alteration in the starting and lighting system which is now the Dyneto two-unit device in place of the system formerly used. A new body is employed to coincide with the tendencies of up-to-date streamline design. The body is built of white ash sawed into shape and not bent. It is covered with sheet metal and the braces are set into the wood at white heat.

Among the technical specifications is a detachable head four-cylinder L-head block motor 3½ bore and 5-in. stroke giving 34.9 hp. on the brake. Connecticut ignition is used, Zenith carbureter, dry-plate clutch and three-speed selective gearset on the floating rear axle.

A honeycomb type of radiator with an aeroplane style fan combine to give efficient cooling. Lubrication is by a combination pressure and splash system in which the main bearings are taken care of by pressure feed from the pump and the oil, after feeding the main bearings, flows to the splash troughs, from which the other bearing surfaces of the motor are lubricated. There is an oil indicator and filter also which form part of the lubricating system. The carbureter is a Zenith fitted with hot air supply.

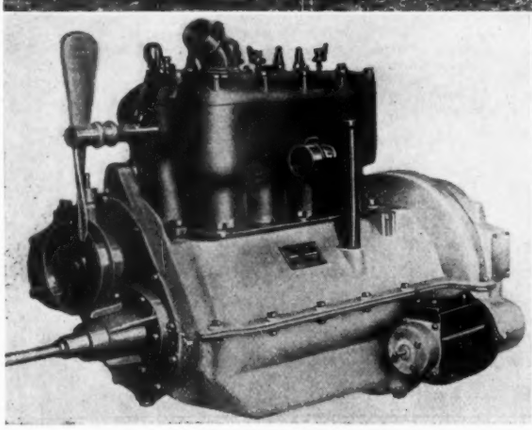
The entire valve system is well worked out. The camshaft has integral cams and is made of a forging of low carbon steel 1 in. in diameter carried on three bearings. The front is 1¼ by 2 15/16. The center is 1.8595 by ¾ in., the rear is 2 9/16 by 1 in. The timing gears are helical in shape, cut to an angle to promote quietness and smooth running. The valves are 1⅜ in. in the clear and are located on the right side of the motor. The pushrods are flat-head type made of special case-hardened steel properly hardened and ground and adjustable by means of hardened adjusting screws and locknuts.

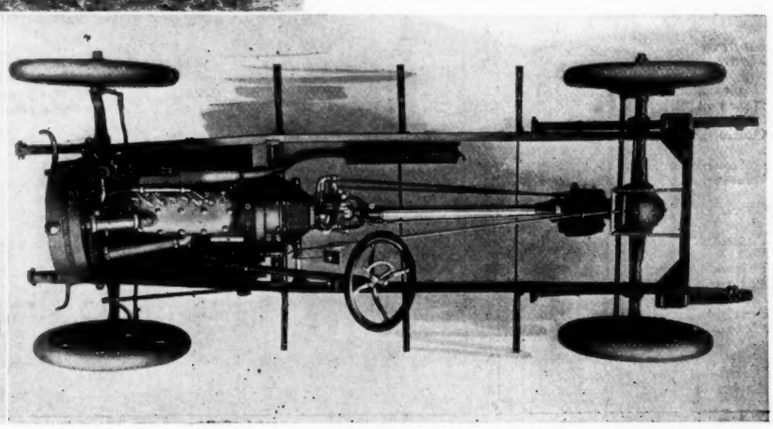


Top—The cloverleaf roadster which features the Crow line for 1917 and which is a new model that has just been introduced. Note the wire wheels and typical lines

Lower left—Three-quarter end view showing the motor used on the Crow 1917 car with its aeroplane type fan and compact layout of cylinders and crankcase casting

Lower right—Plan view of the Crow 1917 chassis showing motor mounting and layout of the drive members with the three-speed selective gearset mounted on the rear end of the propeller shaft adjacent to the rear axle





TYPE AND SIZE OF ELECTRIC LAMP BULBS USED ON THE PRINCIPAL CARS FOR 1916

Car	HEAD-LAMPS		SIDE LAMPS		TAIL LAMP		DASH LAMP		Fuses Amp.	Type of Socket	Wiring System	Type of Dimmer	Method of Focusing	Remarks
	Vol.	Cp.	Vol.	Cp.	Vol.	Cp.	Vol.	Cp.						
Abbott-Detroit	6-8	15	6-8	2H	6-8	2	6-8	2	10	Ediswan S.	Single		Sliding bulb	
Allen	6-8	15	6-8	4	6-8	2	6-8	2	15*	Ediswan S.	Single	Resist.		*Side, Tail and dash lamp fuses 5 amp.
Alter, 8-Cyl	6-8	18			6-8	2			20	Ediswan S.	Single			
4-Cyl	12-16	18			12-16	2			20	Ediswan S.	Single			
Apperson	6-8	18			6-8	2	6-8	2	10	Ediswan D.	Double	Resist		
Auburn	6-8	15	6-8	4H	6-8	2	6-8	2		Ediswan S.	Single		Screw adj	
Austin	6-8	21	6-8	H	6-8	2	6-8	2	15*	Ediswan D.	Single			*Tail and dash lamp fuses 5 amp.
Brewster	12-16	30-40	12-16	6H	6-8	4	6-8	4	10	Ediswan S.	Single			
Buick	6-8	16	6-8	4H	6-8	2	6-8	2	C.B.	Ediswan S.	Single		Adjust. bulb	
Cadillac	6-8	18	6-8	6	3-4	2	6-8	2	C.B.	Ediswan S.	Single	None	Adjust. bulb	
Case	6-8	18	6-8	4H	6-8	4	6-8	4	15*	Ediswan S.	Single		Adjust. bulb	*Side and tail lamps 5 amp.
Chalmers	6-8	15	6-8	4H	6-8	2	6-8	2	15	Ediswan S.	Single			
Chandler	6-8	18	6-8	4H	6-8	2	6-8	2	20	Ediswan S.	Single		Screw adj	
Chevrolet, H2 and H4	6-8	18		H	6-8	2	6	4	20	Ediswan S.	Single		Adjust. bulb	
490	6-8	16			6-8	4			20	Ediswan D*	Single	Series		*Tail lamp Ediswan S.
Cole	6-8	21			3-4	2	3-4	2		Ediswan S*				*Dash lamp Ediswan D.
Corbitt	6-8	16	6-8	6	6-8	4	6-8		6	Ediswan D.	Double	None		
Cunningham	6-8		6-8		6-8		6-8		15	Ediswan S.	Single	None	Adjust. bulb	
Daniels	6-8	21	6-8	4H	6-8	2	6-8	2	15*	Ediswan S.	Single	None	Adjust. bulb	*Side, tail dash lamps 5 amp.
Davis	6-8	16			6-8	4	6-8	2		Ediswan S.	Single	Resist		
Detroiter	6-8	18			6-8	12	6-8	12		Ediswan S.	Single	Series	Adjust. bulb	
Dispatch	12-16	24			6-8	4	6-8	4*		Ediswan D.	Double			*Two dash lamps
Dodge	12-16	15			12-16	2	12-16	2		Ediswan S.	Single	Resist	Adjust. bulb	
Dorris	6-8	15	6-8	4	6-8	2	6-8	2	15	Ediswan S.	Single	Resist	Adjust. bulb	
Dort	6-8	16				6-8	2		10	Ediswan S.	Single	Resist	Adj. socket	
Drummond	6-8	21		4H	6-8	2	6-8	2		Ediswan S.	Single			
Elkhart	6-8	15			6-8	2	6-8	2	20	Ediswan S.	Single	Resist	Adj. socket	
Empire	6-8	15	6-8	4H	3-4	2	3-4	2	10	Ediswan S.	Single		Adj. socket	
Enger	6-8	15			6-8	2	6-8	2		Ediswan S.	Single	Resist	Adjust. bulb	
Farmack	6-8	18	6-8	6H	6-8	4	6-8	4	15*	Ediswan S.	Single			*Side lamps, 10 amp; tail and dash 5 amp.
Fiat	6-8	15			6-8	4	6-8	4		Ediswan S.				
Ford	6-8	15								Ediswan D.	Double		Adj. socket	
Franklin	12-16	21	12-16	4H	6-8	2	6-8	2	15	Ediswan D.	Double		Adjust. bulb	
F. R. P.	12-16	25	12-16	6	12-16	6	12-16	4		Bosch	Single		Adjust. bulb	
Glide	6-8	15	6-8	4H	6-8	2	6-8	2	15	Ediswan S*	Single	None	Adjust. bulb	*Dash lamp Ediswan D
Grant	6-8	15			6-8	2	6-8	2	15	Ediswan D*	Single			*Tail and dash lamps Ediswan S
Haynes	6-8	15			6-8	2	6-8	2	C.B.	Ediswan D.	Double	Series	Adjust. bulb	
Hudson	6-8	15			3-4	2	3-4	2	C.B.	Ediswan S.	Single	Resist	Adj. socket	
Hupmobile	6-8	15	6-8	2H	6-8	2	6-8	2	10	Ediswan S.	Single	Resist		
Inter-State	6-8	15	6-8	2	6-8	2	6-8	2		Ediswan S.	Single			
Jackson	6-8	15		H	3-4	2	3-4	2	20	Ediswan D*	Doub**	Series		*Tail lamp Ediswan S. **Tail lamp single wiring.
Jeffery	6-8	18	6-8	4H	6-8	3	6-8	3	10	Ediswan S.	Single			
Kearns	6-8	12			6-8	4			35	Ediswan D.	Double	Resist		
Kline	6-8	18	6-8	4H	6-8	2	6-8	2		Ediswan S.	Single			
King	6-8	15	6-8	4H	6-8	2	6-8	2	15	Ediswan S.	Single		Adjust. bulb	
Kissel	6-8	18			6-8	3	6-8	3	20	Ediswan S.	Single	Series		
Lexington	6-8	16		H	6-8	4	6-8	4	15*	Ediswan S**	Single	Series	Adj. socket	*Tail lamp 5 amp; **model 0, Ediswan D
Locomobile	6-8	21	6-8	6	6-8		6-8		10	Ediswan S.	Single	Resist		
Lozier Four	6-8	18			6-8	2	6-8	4	10	Ediswan D*	Single	Series	Adj. socket	*Tail lamp, Ediswan S
Six	6-8	18	6-8	4	6-8	2	6-8	4		Ediswan D*	Single	Series	Adj. socket	*Side, tail and dash, Ediswan S
Madison	6-8	15	6-8	4	6-8	4	6-8	2		Ediswan S.	Single			
Marion	6-8	18	6-8	6H	6-8	4	6-8	4	30	Ediswan S.	Single			
Marmon	12-16	24	12-16	8	12-16	8	12-16	8	20	Bosch	Single			
Maxwell	6-8	15			6-8	2			20	Ediswan S.	Single	Resist		
McFarlan	6-8	21	6-8	4H	6-8	2	6-8	2	10*	Ediswan S.	Single		Adj. socket	*Side, tail dash, 5 amp.
Mercer	12-16	24	12-16	4H	12-16	4	12-16	4	6	Ediswan S.	Single	Gr.glass	Adj. socket	
Metz	6-8	15	6-8	4H	6-8	2			20	Ediswan S.	Single			
Mitchell	6-8	15			6-8	2	6-8	2	20	Ediswan D.	Double	Series	Adj. socket	
Moline-Knight	6-8	15	6-8	4	6-8	2	6-8	4	20	Ediswan D*	Doub**			*Model MK-40 tail lamp, Ediswan S. **Model MK-40 Single
Monroe	6-8	15			6-8	2			10	Ediswan D*	Single	Series	Adj. socket	*Tail lamp, Ediswan S
Moon	6-8	15			6-8	4	6-8	4	C.B.	Ediswan S*	Single			*Model 6-30 headlamps, Ediswan D
National	6-8	15	6-8	6H	6-8	4	6-8	2		Ediswan D.	Double		Adj. socket	
New Era	6-8	12	6-8	4H	6-8	2			20	Ediswan S.	Single		Adj. socket	
Oakland	6-8	12			6-8	2	6-8	2	20*	Ediswan S.	Single	Resist	Adj. socket	*Models 38 and 50, circui, breaker
Oldsmobile	6-8	16			6-8	1.5	6-8	1.5		Ediswan S.	Single	Resist	Adjust. bulb	
Overland	6-8	16			3-4	2	3-4	2	20	Ediswan D*	Single	Series	Adj. socket	*Tail lamp and dash lamp, Ediswan S
Owen	28	24	28	4H	28	2	28	2		Ediswan D.				
Packard	6-8	24	6-8	4	3-4	2	6-8	4	10	Ediswan D.	Double		Adj. socket	Auxiliary headlamp bulb 6-8 V, 6 Cp.
Paige-Detroit	6-8	15	6-8	4H	6-8	2	6-8	2		Ediswan S*			Adj. socket	*Dash lamp, Ediswan D
Paterson	6-8	12	6-8	2	3-4	2				Ediswan S.	Single	Series		
Pathfinder	6-8	18	6-8	4H	6-8	2	6-8	2	C.B.	Ediswan S*				*Dash lamp, Ediswan D
Peerless	6-8	15	6-8	4H	6-8	2	6-8	2	10	Ediswan S.	Single		Adj. socket	
Pierce-Arrow	6-8	21	6-8	4	6-8	4	6-8	4	10*	Ediswan S.	Single	Resist	Adjust. bulb	*Side, tail and dash lamp 5 amp.
Pilot	6-8	16			6-8	2	6-8	2	10	Ediswan S*	Single	Resist	Adj. socket	*Dash lamp, Ediswan D
Premier	6-8	15	6-8	4H	6-8	2	6-8	4	10	Ediswan D.	Double	Resist	Adj. socket	
Pullman	6-8	15			6-8	2	6-8	2		Ediswan S.				

Car	HEAD-LAMPS		SIDE LAMPS		TAIL LAMP		DASH LAMP		Fuses Amp.	Type of Socket	Wiring System	Type of Dimmer	Method of Focusing	Remarks
	Vol.	Cp.	Vol.	Cp.	Vol.	Cp.	Vol.	Cp.						
Regal	12-16	21	.....	.....	12-16	2	12-16	2	.....	Ediswan D*..	Single..	Series..	.....	*Tail lamp, Ediswan S
Reo	6-8	15	.....	.....	3-4	2	3-4	2	5	Ediswan D...	Double.	Series..	Adj. socket...	
Ross	6-8	15	6-8	4H	6-8	4	6-8	.....	.....	Ediswan D...	Double.	.....	Adjust. bulb..	
Saxon	6-8	15	.....	.....	6-8	2	6-8	2	15	Ediswan S*..	Single..	Resist..	Adj. socket...	*Dash lamp, Ediswan D
Scripps-Booth	6-8	16	6-8	4H	6-8	2	6-8	2	.....	Ediswan S...	Single..	.....	Adj. socket...	
Simplex	6-8	40	.....	.....	3-4	2	6-8	2	10	Ediswan S*..	Single..	.....	.....	*Tail lamp, Ediswan D
Singer	6-8	21	6-8	6H	6-8	2	6-8	2	5	Ediswan S*..	Single..	.....	.....	*Dash lamp, Ediswan D
Spaulding	6-8	15	6-8	2H	6-8	2	.....	.....	.....	Ediswan S...	Single..	.....	.....	
Standard	6-8	15	6-8	4H	3-4	2	3-4	2	15*	Ediswan S...	Single..	.....	.....	*Tail and dash lamp 5 amp.
Stanley	6-8	18	6-8	4H	6-8	2	6-8	2	15	Ediswan D...	Double.	.....	.....	
Stearns	12-16	20	.....	.....	12-16	2	12-16	2	20	Ediswan S...	Single..	Resist..	Adj. socket...	
Sterling	6-8	16	.....	.....	6-8	3	.....	.....	20	Ediswan S...	Single..	Resist..	Adjust. bulb..	
Stewart	6-8	15	6-8	2	6-8	2	6-8	2	15*	Ediswan S**.	Single..	.....	Adjust. bulb..	*Side, tail and dash lamp 5 amp. **Dash lamp, Ediswan D
Studebaker	6-8	12	.....	.....	6-8	2	6-8	2	10	Ediswan S...	Single..	Resist..	Adj. socket...	
Stutz	6-8	21	6-8	4H	6-8	2	.....	.....	.....	Ediswan D...	Double.	.....	Adj. socket...	
Velie	6-8	15	6-8	4H	3-4	3	3-4	3	5	Ediswan S*..	Single..	.....	Adjust. bulb..	*Dash lamp, Ediswan D
White	18-24	21	18-24	4	18-24	2	.....	.....	.....	Ediswan D...	.....	.....	.....	
Winton	6-8	21	6-8	12H	6-8	4	6-8	2	20	Ediswan S...	Single..	.....	Adjust. bulb..	
Westcott	6-8	15	6-8	4H	3-4	2	3-4	2	.....	Ediswan S*..	Single..	.....	Adjust. bulb..	*Dash lamp, Ediswan D

NOTE—Where headlamps have small bulbs for side lamps, the candlepower is followed by the letter H. **ABBREVIATIONS—Type of Socket:** Ediswan single contact, Ediswan S; Ediswan double contact, Ediswan D; Circuit breaker, C.B.; **Dimmer:** Resistance, Resist; Series connection, Series.

Roller Bearing Takes Thrust in Novel Way

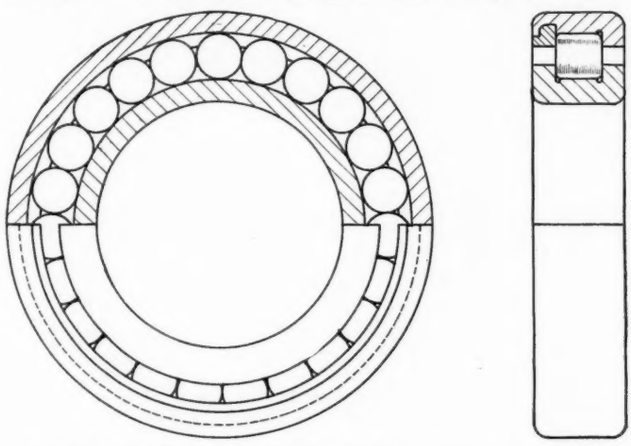
Acts as Parallel Roller for Journal Loads and as Self-Lubricating Plain Bearing Under Thrust—Intended Especially for Road Wheels

AXLE engineers have good reason to study bearing design closely, thus a new type produced by A. M. Laycock, chief engineer of the axle department of the Sheldon Axle & Spring Co., Wilkes-Barre, Pa., is deserving of more than passing interest. Mr. Laycock has had the opportunity of studying ball and roller bearings of all kinds in service, and has come to the conclusion that the latter type are well adapted for the wheel bearings of trucks. He has been using several well-known types with great satisfaction and is now making, and experimenting with, a design of his own.

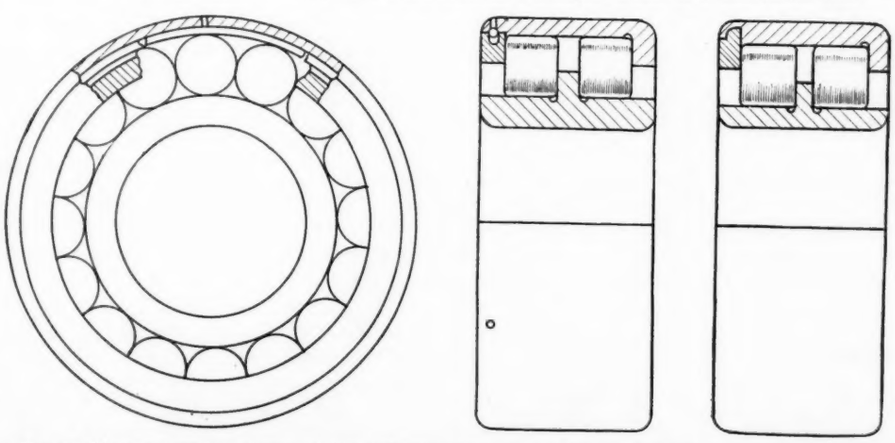
In this special bearing parallel rollers are used either with a cage for separating them or else with the race filled completely and the rollers touching each other. The rollers lie between flanges, and are finished off square at the ends, so that end pressure is taken on the ends of the rolls. Of course, this gives a purely sliding contact and so approximates to a plain thrust bearing, but it will be noticed in the illustrations that the rollers lie in a channel section race. This channel naturally is filled with oil, so that each roller entering the bottom part of the bearing passes through a bath of lubricant and the revolution of the roller spreads the oil well over the thrust surfaces.

Single and Double-Row Bearings

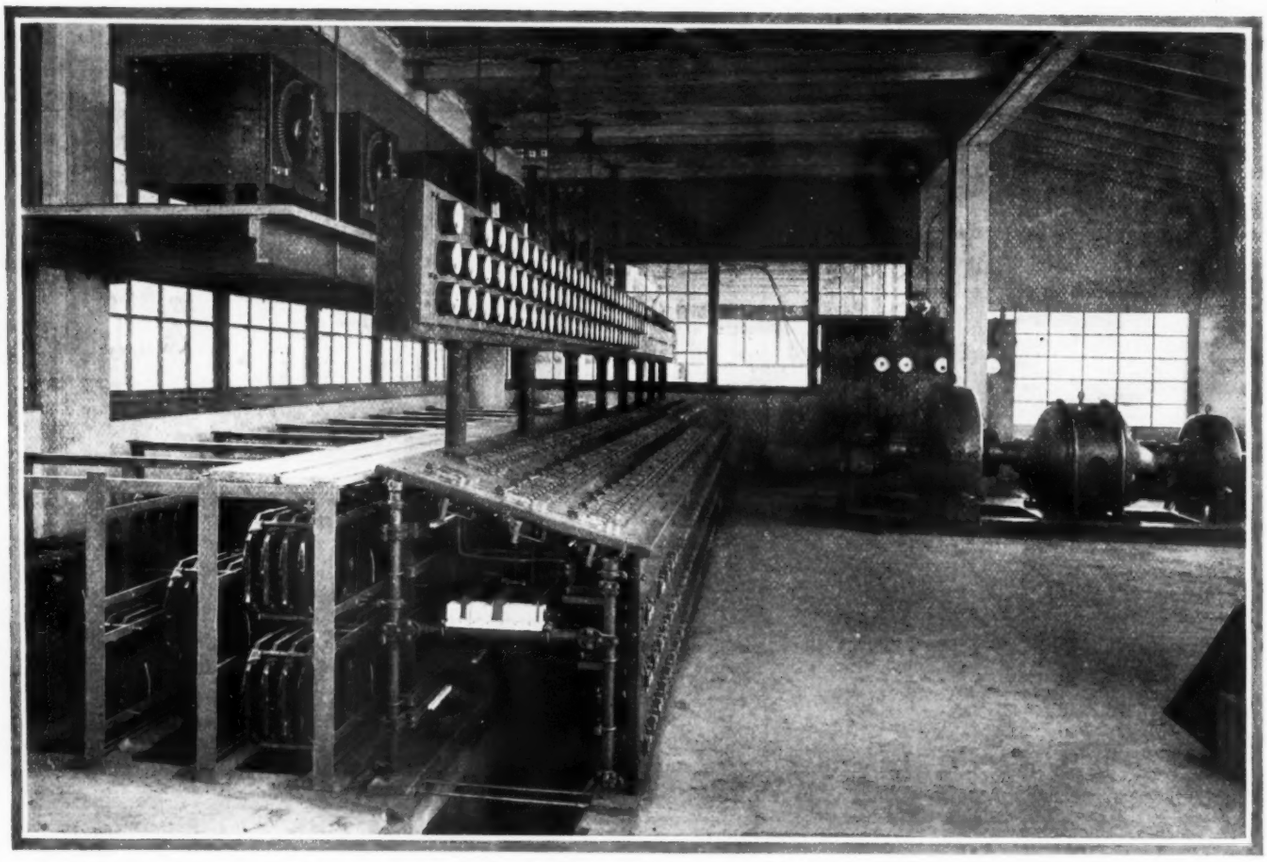
The experimental types now being made include both single and double row bearings, and several ways have been worked out for fitting them together. In the sections shown, the narrow, single row bearing has the outer race turned with a thin edge on one side. When the rollers have been put in the thrust ring is put in place and the thin edge is then rolled over by a burnishing tool. This same design is shown for one of the double row bearing sections, but the other has a different scheme. In the latter the loose thrust ring is grooved, as is the inner edge of the outer race. A sort of piston ring is pressed into the groove in the thrust race and this expands on the two grooves coming into register, so locking the parts together.



Laycock special single-row roller bearing. Note how the outer race is turned with a thin edge on one side and rolled over



The double-row bearing shown at the extreme right is similar to the single-row in its construction but the other uses a sort of piston ring pressed into the thrust race groove and this expands on the two grooves coming into register, locking the parts. Pressing the ring with the several pins similar to that illustrated, these pins being inserted through holes in the outer race, allows the bearing to be readily disassembled



Rheostats, desk control, motor generator set and switchboard in acid proof room of Prest-O-Lite storage battery plant

Prest-O-Lite Adds Charging Apparatus

Installation Includes Ninety-Six Independent Charging Circuits with Second Largest Desk Board Control in the World

IN connection with the program of the Prest-O-Lite Co., Inc., of Indianapolis, Ind., to manufacture storage batteries on a large scale an electrical charging apparatus having many new features has been installed. The installation provides ninety-six independent charging circuits controlled from a desk having sixteen slate sections by an operator who is in full view of every forming table on the main floor of the plant. The current supply has been carefully worked out with the idea in view of utilizing the discharge current from the batteries on the forming tables by passing it back through a booster generator where it is raised to the charging voltage and then used over again. The exact method by which this is accomplished is described later. Another of the striking features of this installation is the novel method of automatically disconnecting the incoming A. C. current, which is 4100 volts, and disconnecting the D. C. generators from their loads to prevent the discharge of the batteries back into the machines in the event of any great fluctuation in the A. C. voltage, overloading of the apparatus, or racing of the motor.

Control Equipment in Glass Room

The control desk by means of which the current is regulated for each of the ninety-six charging circuits is distinctly a new departure. It is said to be the second largest desk board installation of its kind in the world, one larger having been made up in this country for shipment to the Japanese government.

The entire control equipment is installed in a fume-proof glass room supplied with fresh air from an outside source. It is in this room that the operator works. It will be seen that while enjoying a full view of the entire floor in the forming department, by line of vision between the top of the benchboard and the bottom of the instrument frame, the entire apparatus is completely removed from the destructive acid fumes.

Underground Lead Cables Used

The current is carried from the control desk to the forming tables by lead cables in underground fiber conduit. The terminals at the tables are specially designed potheads, there being one, two and four conductors, according to the carrying capacity of the circuit and the location of the table. The potheads protrude through the floor which is constructed of acid-proof brick laid in asphaltum. The lines of batteries on charge are connected to the potheads during the forming process by means of flexible cable.

The incoming current is protected at the pole by a pole top switch, equipped with horn gap spark arresters, and an aluminum cell electrolytic lightning arrester located at the point of entrance to the building.

Among the New Automobile Books

Three Volumes Which Give Complete Information on the Design, Construction and Operation of Lathes, Modern Automobile Electric Systems and Car Repairing

INFORMATION of interest to the engineer, the repairman and garageman, and, last but not least, the automobile owner, is contained in the three books briefly reviewed herewith, these volumes being recently issued by the publisher, the Norman B. Henley Publishing Co. One of these works is a revised edition of Perrigo's book on lathe design, construction and operation, and bringing the subject matter up to date. The other two are by Pagé, one of them taking up the intricacies of the modern automobile electric system and describing the systems and detail and suggesting remedies for various troubles, and the other is a complete outline and description of the best shop methods, equipment and processes in automobile repair work.

Lathe Design, Construction and Operation. By Oscar E. Perrigo.—A new revised edition covering the subject suggested by the title up to date.

Lathe history and the relations of the lathe to manufacturing are given; also a description of the various devices for feeds and thread cutting mechanisms from early efforts in this direction to the present time. Lathe design is thoroughly discussed, including back gearing, driving cones, thread cutting gears, and all the essential elements of the modern lathe. The classification of lathes is taken up, giving the essential differences of the several types of lathes, including, as is usually understood, engine lathes, bench lathes, speed lathes, forge lathes, gap lathes, pulley lathes, forming lathes, multiple-spindle lathes, rapid-reduction lathes, precision lathes, turret lathes, special lathes, electrically driven lathes, etc. In addition to the complete exposition on construction and design, much practical matter on lathe installation, care and operation has been incorporated in the enlarged 1916 edition. All kinds of lathe attachments for drilling, milling, etc., are described and complete instructions are given to enable the novice machinist to grasp the art of lathe operation as well as the principles involved in design. A number of difficult machining operations are described at length and illustrated.

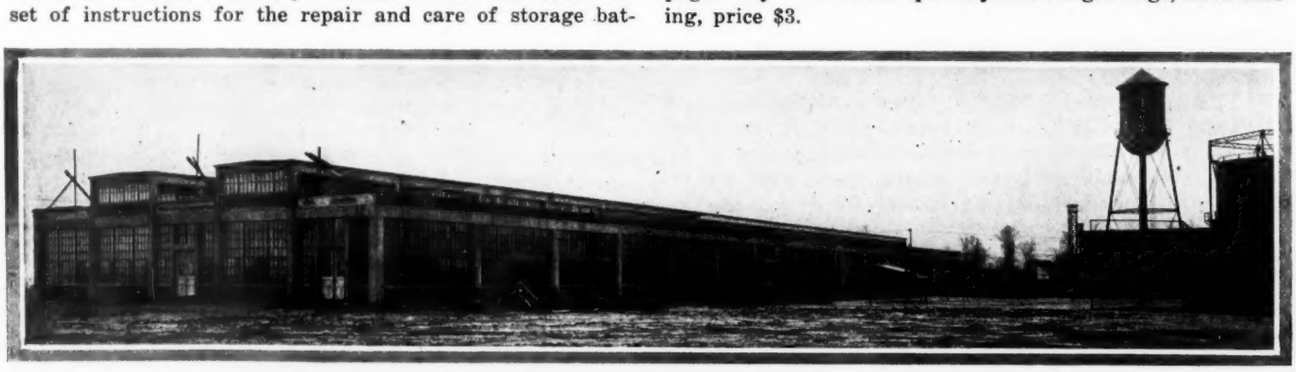
Large clear type and a clear style make this a desirable reference book. Published by Norman W. Henley Pub. Co., New York City, 400 pages 6 by 9; over 1800 illustrations, cloth binding, price $2.50.

Modern Starting, Lighting and Ignition Systems. By Victor Pagé.—A study of the construction and repair of up-to-date automobile electricity. In this work is included a full set of instructions for the repair and care of storage batteries, generators, regulating devices, starting motors, etc. The systems representing various classes of practice are described in detail and illustrated by complete diagrams showing the connections and the relations of the various parts of the assembly to each other. Data for the location of trouble in the various systems is given and there is also included a description of the various accessories which are operated from current supplied by the storage battery.

In the present state of uncertainty among non-technical owners and those not familiar with the principles of electricity this work should fill a useful purpose. Published by Norman W. Henley Pub. Co., New York City. Over 500 5½ by 8 pages with nearly 300 engravings and folding plates. Cloth binding, price $1.50.

Automobile Repairing Made Easy. By Victor W. Pagé.—Deals with shop methods, equipment and processes and is a complete treatise explaining approved methods of repairing all parts of all types of gasoline automobiles. This is a reference work for anyone engaged in the repairing of cars and outlines every process incidental to motor car restoration. Gives plans for workshop construction, suggestions for equipment, power needed, machinery and tools necessary to carry on business successfully. Tells how to overhaul and repair all parts of all automobiles. The information given is founded on practical experience, everything is explained so simply that motorists and students can acquire a full working knowledge of automobile repairing. Other works dealing with repairing cover only certain parts of the car—this work starts with the engine, then considers carburetion, ignition, cooling and lubrication systems. The clutch, change speed gearing and transmission system are considered in detail. Contains instructions for repairing all types of axles, steering gears and other chassis parts. Many tables, short cuts in figuring and rules of practice are given for the mechanic. Explains fully valve and magneto timing, tuning engines, systematic location of trouble, repair of ball and roller bearing, shop kinks, first aid to injured and a multitude of subjects of interest to all in the garage and repair business. All illustrations are especially made for this book, and are actual photographs or reproductions of engineering drawings.

Students as well as repairmen should find this a handy work as it is treated in a non-technical manner. Published by Norman W. Henley Pub. Co., New York City. Over 1000 pages 5 by 8 with 1000 specially-made engravings, cloth binding, price $3.



The new storage battery factory addition to the plant of the Prest-O-Lite Co., Inc., Indianapolis, Ind.

Paragraphs on Current Topics

By Marius C. Krarup

Motto: Radical Thought, Conservative Action.

More and more it becomes apparent that the automobile and motor industries are factors in all the big events of the moving world and near to the central forces in new developments. The automobile engineer who knows his book from A to Z, and also where its wisdom ends, is the most enviable of mankind for his opportunities.

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If physicians had an S. A. E. and a live journal, there would be a public discussion on the human machine after 1300 Marathonian aspirants had struggled over 13 miles of roads and metropolitan streets, as they did last week in New York, only to be compelled at the end to yield first and second place to two durable Finns—two machines evolved abroad. Seventeen New York sporting editors, more or less, would then be enabled to make the welkin ring for a week or two with spirited argument on the proposition that the enduring human motor must be built up on a frugal diet from infancy, since nowhere in animal motordom the heavy eaters of meat make good for anything but spurts. Come on, physicians! Follow the lead of automobile engineers. Take your avocation in earnest and trust the public to reward the most capable. Remember, you should have a representative or two on a National Committee for Physical Preparedness. All are interested in the human motor.

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Apropos of this watchword of the moment—Preparedness—which concerns the automobile industry so intimately, one national lesson is already written in luminous letters. A great sentimental sweep must precede every appeal to mere intelligence before the public gets deeply stirred. Every big business man probably knows this open secret intuitively. Every howling success is based upon it. The original Fordist inducement was the sentiment: "We, too, can be motorists," and the price did not stand in the way; neither was any detracting compromise offered in the type of the motor or in the possible speed; the sentiment was all there. There is money and results in sentiment well backed up. In almost any other country Preparedness would be considered a subject to be dealt with in commissions and committees first, and no statesman would venture to build up in advance a supporting sentiment on one glittering and abstract word. The American method, however, gets results in one-tenth of the time, and perhaps just as good ones. In some things we can guess as near right in a minute as in a month, and probably there is more guesswork in the biggest things than over-serious statesmen suspect. Hurrah for America! For sentiment first and specifications afterward. That makes things move.

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F. P. A., celebrated jokesmith, initialist and manager of the "zink" for a New York daily, is tempted to give away his Jitnibus of Joy because a tire costs as much as a set of Hardy's books and produces less enjoyment. Just try it, brother, with one tire off and a set of Hardy's on board. Good rules work both ways.

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"By learning a few rules and phrases every dolt now has a chance to become an efficiency expert and eventually an automobile owner," complains *Index of Contemporary Thought* gravely. Well, is not that a great step toward ability? Has anybody discovered a better method for improving dolts? They used to become dramatic critics or "flanneled oafs"; yet both the drama and tennis survive. Efficiency, too, can endure them.

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Speculation on automobile design for coming years is more rife than ever, probably because most of recent changes have been inaugurated by prominent firms, making previous standards seem like mere commercial chaff that can be blown away by anybody whose wind is good. But commonly the speculation does not rise far above mechanical considerations of small complexity. Among repair shops in New York we find that a pretty industrial race is looked for between the spiral bevel gear and the worm drive, for ordinary cars. The reasoning, patched up from different sources, rounds up about as follows. It starts with a certain new fondness for the worm, coupled with objections to the sluggishness of worm-drive vehicles in the garage. Further, if this sluggishness or lack of coasting efficiency is remedied by trebling the diameter of the worm, the great gear reduction and the extra margin for road clearance are lost, and there are left only silence and relative immunity to wear (contingent upon careful lubrication); and these properties the spiral bevel and the worm have in common, though perhaps not in equal degree. It may then come to pass, where motors of more than 2000 r.p.m. are wanted, that the final drive will be taken by short shafts with universals to the wheels, or to internal gears in the wheels, while unsprung weight is reduced by hanging the spiral bevel gear or the worm gear in the vehicle frame. The rear wheels could then be dished or inclined, like front wheels, as may be advantageous with twin tires on crowned roads. But similar results—excepting the reduction of unsprung weight—could be secured with ordinary wheel drive by using the Renault or Mercedes compound rear drive (mainly used in trucks of these makes) comprising a special differential and double bevel gears, with spur gears, for further reduction of the ratio, to the inner ends of the wheel shafts. The demand for high-speed motors in conjunction with the desire for silent operation seems to lie at the bottom of these speculations which arrive at no definite conclusions but show the drift of ideas.

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Suddenly there looms up from unexpected quarters—in this case from inventive but unindustrial Denmark—the proposition of an entirely new transmission system which may check all speculations about minor changes in design. A revolutionary plan, like Jakobsen's (described in THE AUTOMOBILE of May 11) might have the same reactionary effect, while its merits are being investigated, as that which followed, with regard to motor design, the acceptance of the Knight motor by the British Daimler company and lasted for a couple of years. With its suspended rear axle and brakes on the transmission only, the Jakobsen design reduces unsprung weight radically, while the independent spring action for each wheel almost promises speed and comfort on a corduroy road (if the wood is laid bias, as it ought to be, but seldom is). In examining the designer's drawing, it is noticed, however, that the movement of the cantilever spring, as planned, scarcely can be reconciled with that of the wheel spindle, so that we know for a certainty that this surprising mechanism so far exists on paper only. But its whole plan is so unusual and bold that one hopes to see the little slip

remedied, as easily may be done by a shackle action, and the whole system entered among actual types of automobile design. It seems to solve, very largely, the knotty problem of cushioning the horizontal component of a road shock, for the driving wheels.

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The current doctrine on unsprung weight claims a big share of attention in the possibilities referred to in preceding paragraphs. But there is something peculiar about this doctrine. It does not hold good under all conditions. Truck people find that tire wear depends on total weight and service conditions and that no special effect of unsprung weight can be traced. Many car owners hold that a heavy axle has no effect to spoil their comfort. Only with regard to light vehicles is there something akin to unanimity against unsprung weight. Now add the assumption that bad effects from excessive unsprung weight are mostly felt at moderate vehicle speeds—as is pretty well sustained in practice—and it becomes possible to get a nearer view of this important but tottering doctrine. First let it be admitted that tire inflation for light vehicles (say 60 pounds pressure under a body and load weight of 1000 pounds) is higher in proportion than that used with heavier vehicles (say 90 pounds under loads of 3000 pounds). Similarly, that the solid tire is more elastic for a light vehicle, which does not compress the rubber compound to its yield limit in advance of any shock, than for a truck. Now, comparing all reports, there is no difficulty about reconciling them. They all agree in this that the unsprung weight is most objectionable when it is not really unsprung; that is, when it is supported on actively elastic tires. One might say "re-actively elastic tires" to express the idea that at high speeds the elastic reaction of the tires gets small opportunity to spend itself against the unsprung weight and the vehicle springs above it. This is perhaps as far as one paragraph will take this subject. To go further with mere reasoning might challenge contradiction. Let it stand just like this for a while: Unsprung weight affects tire wear and comfort most at medium speeds—10 to 25 miles per hour—and when mounted upon tires of relatively powerful elasticity. Or, if a paradox is preferred: Unsprung weight is worst when not unsprung.

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"Heads Up" and "Crossing at Corners" is the double title for three pages in the *American Magazine* recommending the disciplining of pedestrians and strict examinations for chauffeurs. F. U. Adams lends his name to the plan. With these safeguards and prompt revocation of driving licenses for transgression of traffic rules, he has convinced himself, vehicle speed can be given free up to 35 miles per hour for cities and higher for the country. Mr. Adams' theory is to scare everybody into an abnormal state of wide-awakeness, and the idea is borrowed, he says, from London and Paris. But the war has discouraged Americans from borrowing European ideas which in the end lead to a clash. And plain arithmetic persists in telling us that, in the traffic system which we shall adopt eventually, neither shall safety depend entirely upon the chauffeurs—which means reducing safety 50 per cent in advance—nor shall pedestrians be second-class traffic members, nor shall a costly army of traffic police be required for enforcing more or less arbitrary and injudicious rules. The automobile industry has managed to grow prosperous without embracing or subsidizing any measures savoring of subjugation for the general public—who in America are pedestrians one day and motorists the next—and can afford to continue on easy lines of evolution, cultivating by degrees a public opinion and public habits which eventually will solve the problem of securing both safety and freedom for all. On Adams' plan safety depends too much on others and too little on self.

Diesel Motors for Vehicle Work

THE question of forced fuel feed, rather than fuel feed by suction, and that of adapting the Diesel principle to automobile purposes are closely related, the object in both cases being the utilization of cheap fuels with full cylinder charges and a combustion—of excess lubricant as well as fuel—so complete as to forestall, in a great measure, the formation of carbon deposits. To combine these objects with the light weight and the highly sensitive throttle control required for automobile purposes represents a task which has engaged designers for a number of years and which the general fuel situation now renders more important than ever.

In practical familiarity with small Diesel engines Europe is ahead of America and it is therefore of more than ordinary interest to present the European view of the necessities and probabilities in the situation. The *Commercial Motor* of April 6 offers material of this nature in an article explaining the Diesel system on the assumption that the reader is not previously acquainted with it and suggesting the modification illustrated in the accompanying sectional view. The article explains in substance as follows:

Explanation of Diesel System

Little progress has as yet been made as to the development of the Diesel engine in making it suitable for installing in commercial vehicle chassis. The difficulties of design undoubtedly increase as the size of the engine decreases. The principle of working is as follows:

The engine is made in three forms, viz., as a four-stroke-cycle single-acting engine, as a two-stroke-cycle single acting, and as a two-stroke double-acting engine. An essential feature in the actual Diesel engine is that it requires, besides its own cylinders and pistons, an auxiliary air compressor capable of producing a pressure of up to 700 lb. per square inch. The principal difference between the Diesel cycle and the ordinary gasoline motor cycle is that air only is compressed in the cylinder instead of a mixture of air and fuel.

In the four-stroke Diesel engine there is an air inlet valve, a fuel valve, and exhaust valve worked by cams, and a valve for starting purposes.

First (down) Stroke.—The inlet valve is opened during the whole of the stroke, and the cylinder becomes filled with atmospheric air at atmospheric pressure.

Second Stroke.—The air valve is closed and the piston returns to the top of the cylinder compressing the air. The clearance is so proportioned that in ordinary working the pressure becomes about 500 lb. per square inch and the temperature of the air about 1000 deg. Fahr. Near the end of the stroke a quantity of fuel is injected through the fuel valve into the cylinder by means of a blast of compressed air supplied from the auxiliary air compressor. The construction of the fuel valve is such that the oil is divided into a spray of fine particles. These, coming into contact with the very hot air, ignite automatically, and combustion takes place, increasing the pressure in the cylinder.

Third (down) Stroke.—The fuel valve remains open for about one-tenth of the stroke. During this portion of the stroke the pressure remains practically constant, about 600

lb. per square inch. During the remainder of the stroke the products of combustion expand. This stroke is the working stroke.

Fourth Stroke.—The return of the piston (during which time the exhaust valve is open) drives out the burnt gases. After this the cylinder starts afresh.

The Two-Stroke Type

In the two-stroke engine, the cylinder head is similarly fitted with fuel valve and air valve for starting purposes, and with an air valve called a scavenging valve, but the exhaust valve is replaced by ports cast in the cylinder walls. In some makes of two-stroke engine, scavenging ports are also cast in the sides of the cylinder. The cycle of operations is then as follows:

When the piston is at the bottom of the stroke, the cylinder is full of air at atmospheric pressure, which air has just been admitted through the scavenging valve. During the up stroke the air is compressed to a high pressure, and attains a high temperature. At the top of the stroke, fuel is injected by the blast of air into the hot air within the cylinder, combustion takes place, and the gases expand, thus acting on the piston. When the piston has reached about six-sevenths of the down stroke, the piston commences to uncover the exhaust ports cast in the cylinder walls. The scavenger valve opens and air is admitted under low pressure, about 5 lb. per square inch, which blows out the burnt gases and fills the cylinder with air ready for the next compression stroke. Different arrangements are used by different makers for supplying the scavenging air, some makers using a separate air pump, other makers using a stepped or double piston.

In the double-acting engine the piston is attached to a piston rod which works through a gland and metallic packing at the bottom of the cylinder. A cycle of operations, similar in action to that described for the two-stroke engine, takes place at both ends of the cylinder.

Difficulties and Variations

From the foregoing descriptions it will be seen that various difficulties arise in the design of the Diesel engine. The engine requires to be stoutly designed, owing to the high pressure involved. The high temperatures attained make it necessary for careful attention to be given to the cooling of the various parts of the engine, and the air compressors necessary for supplying the air for starting purposes and for fuel injection, and the fuel valves themselves, all present difficulties which, although overcome in large engines, tend to put the Diesel engine at a great disadvantage when used for comparatively small powers.

Various makes of small-power, semi-Diesel engines have appeared which require no compressors for starting or injecting the fuel. These engines have a much lower compression than the purely Diesel engine, varying from about 120 lb. to 200 lb. per square inch, but they require blow-lamps to heat up the cylinder heads for starting purposes. On the cylinder head a bulb-shaped chamber is formed, which is heated by means of the blow-lamp. Into this chamber the air drawn into the cylinder is compressed. The temperature of the air is increased by the hot bulb and by the increase of the pressure. Fuel is injected into the cylinder by means of an oil pump, and the pressure due to the combustion of the fuel acts on the piston.

Example of Modified Diesel Motor

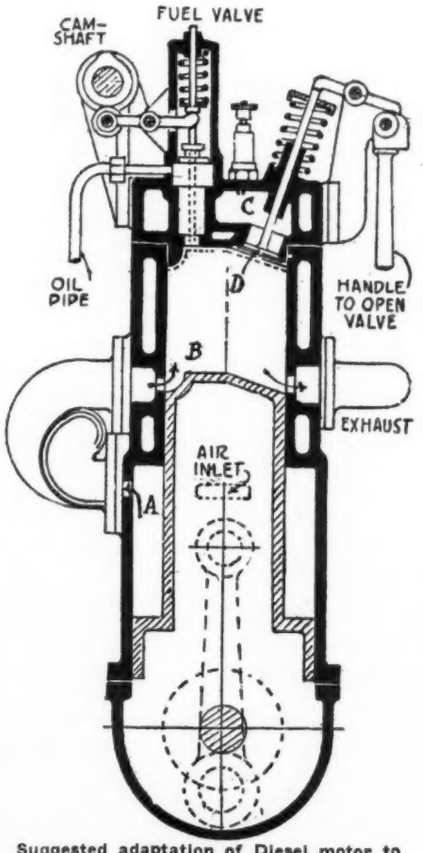
Various methods have been invented for reducing the compression in small motors intended to work on the Diesel cycle. One of these is illustrated herewith, showing a section through a two-stroke, two-cylinder motor having a stepped piston, the larger one acting as an air pump for scavenging.

By this particular method the invention is intended to provide a scheme by means of which the engine could be started as an ordinary gasoline engine by rotating the crankshaft. It is obvious that in an ordinary Diesel engine it would be impossible to turn the motor over the centers, owing to the high compression. Cast in the cylinder covers is a chamber *C* which can be put into communication with the working cylinder through the valve *D*. This chamber is used for burning gasoline supplied by an ordinary carbureter and incidentally for reducing the high compression, so that the motor may be started by rotating the crankshaft. A valve is introduced in connection with the inlet valve of the motor, which may allow it to draw either pure air or a mixture from the carbureter.

To start this particular engine, the valve *D* is opened, putting chamber *C* into communication with the cylinder. A mixture of air and gasoline is drawn into chamber *A* through the air inlet on the downstroke of the stepped piston. On the upstroke the gas is transferred into the upper part of cylinder *B* and is compressed into chamber *C*. It is ignited by means of a spark plug, and the combustion of the gas sets the engine in motion. Heavy oil is now injected into the cylinder through the fuel valve, the gasoline supply is cut off, and pure air is drawn into the cylinder. Valve *D* is shut and the spark plugs are also put out of action. Exhaust takes place through ports cast in the cylinder wall. The engine is now working on the pure Diesel system.

Such a scheme could probably be applied to the hot-bulb type of motor, so that a blow-lamp could be dispensed with. The motor would use gasoline as fuel until it was sufficiently hot for combustion to take place when oil was injected into the air in the cylinder. The gasoline supply could then be cut off. After so starting the motor could be run as a hot-bulb motor.

It seems probable that if an engine is developed suitable for use on commercial vehicle chassis, it will not run on the pure Diesel cycle, but some sort of engine will be developed that can be started as an ordinary gasoline engine and afterward changed over to run on the Diesel or the hot-bulb system, or some combination of these methods. After much experience, a solution of the problem may perhaps be found along these lines, and although the difficulties are much greater than appear at first sight, the proposition is far from hopeless, seeing that Diesel and semi-Diesel engines have been adapted to other branches of employment with success.



Suggested adaptation of Diesel motor to vehicle work

The FORVM

A CAR WITHOUT A DIFFERENTIAL CAN NEVER BE A SUCCESS BECAUSE IN MAKING TURNS ONE-HALF THE TRACTION MUST BE OVERCOME BEFORE THE TURN CAN BE MADE—MANEUVERING AND TIRE WEAR

Fuel Consumption and Tire Wear without Differential

By George D. Bailey
Gearless Differential Co.

THE writer, with the assistance of several prominent engineers, among them W. H. Diefendorf, chief engineer, New Process Gear Corp., Syracuse, N. Y., and F. W. Hawes, consulting engineer, formerly chief engineer for the Cadillac Motor Car Co., Detroit, Mich., has spent about five years in perfecting an improved differential. During that time innumerable tests have been made covering differential action and also every known type of differential, and our experience is based on actual practice and not theory, which is as follows:

A car without a differential will never be a success because before differential action can take place, such as turning corners, one-half of the traction must be overcome before the turn can be made. The inner shaft has an overload of the resistance offered in overcoming the drag of the outer wheel so that it can slip and allow the car to make the turn.

This necessary slippage is divided about equally on both wheels when traction is equal, and is, of course, greater at the wheel with the least traction. This necessary slippage, by the way, is about 7 ft. 4 in., or nearly a complete revolution of a 30-in. wheel. Were traction made great enough, either by excessive load, spikes or cleats, it would be impossible to make a turn without some driving parts being broken or the motor being stalled. The differential could be dispensed with under certain conditions, but it would be absolutely necessary to increase the strength of all driving parts, which would, of course, necessitate more power, more weight, greater cost and unnecessary waste of fuel and tires.

We believe it should be plain to anyone that a car or truck having sufficient power and strong enough driving parts to be efficient without a differential has more power and heavier driving parts than are necessary with the differential.

Classified in Four Types

This differential proposition can be divided into four classes or types:

No differential.
Spur or bevel (balanced gear).
Spiral or worm (internal friction).
Bailey gearless (slow wheel drive).

The efficiency in differential action can be determined by the power required to equalize the difference of travel of the driving wheels. With no differential, having to overcome one-half of the traction, we will put the loss at 50 per cent. With the internal friction type, in order to be anywhere near efficient, prevent wheel spinning and give a semi-positive drive, this should be placed at not less than 25 per cent. The conventional gear type, owing to differential friction, about 12½ per cent. The slow wheel drive, due to an absolute free release of the faster wheel, 00 per cent.

It is generally assumed that the differential is necessary only for making turns. We have found that the aggregate of differential action is usually greater in the straightaway than in making turns. This is from the fact that practically all road surfaces are made up of miniature hills and hollows, and the wheel going into the hollow or over the hill is running ahead; consequently, there is almost constant differential action, so that any differential that consumes extra power, more fuel and excessive tire wear in turning, does the same thing to a certain extent in the straightaway.

We do not believe that the public will take kindly to the extra fuel consumption and tire wear in the no-differential job. Besides, we are quite sure that, even disregarding the greater power necessary, that the cost and weight will be actually more than with an efficient positive drive differential.

A perfect differential is one that has the virtues of no differential, namely, its positive drive, which means no wheel spinning, side-sway, etc., and will allow the outer wheel to run ahead freely. An efficient slow wheel drive type has identically this action and automatically performs every differential function.

Maneuvering a Factor in Eliminating Truck Differential

By L. C. Crilley

FOR several weeks I have been following with much interest the discussion of the advisibility of eliminating the differential for motor truck rear axles. Many ingenious and thoughtful arguments have been advanced both in advocation of this plan and against its practicability, but as yet no one seems to have mentioned a factor in the situation which seems to me of sufficient importance to warrant at least passing consideration. This is the tremendous amount of expense due to increased tire wear which the great amount of backing around necessary with commercial vehicles would cause if the differential were not used.

If you have ever paid much attention to the loading and unloading of motor trucks, especially the large and cumbersome vehicles used in hauling and other heavy freight work, you have doubtless been struck with the great amount of negotiation and manipulation required to place the machine in the proper position for loading or unloading. Perhaps it occurred to you at the time that this maneuvering as well as that required by traffic conditions must entail a considerable waste of fuel and lubricating oil as the engine is always kept running and its speed constantly changed; perhaps you have also pondered on the unnecessary tire wear as well as that upon mechanical parts of the machine. But when one realizes that these operations are gone through by each truck many times a day this waste and wear expense begins to assume astonishing proportions. Increasing this to the degree which would be caused by the elimination of the compensating action of the differential would seem to me exceedingly unwise.

The History of the Pneumatic Tire—4

Bradford's Tire Patent of 1868—Greene's Patent on Flat Rubber Strip on Iron Tire—Thompson's Solid Types—The Forerunner of the Modern Tire Chain

The History of the American Automobile Industry—31

By David Beecroft

CLOSE to the Goodyear patent of 1854, for vulcanizing, are the patents of Marcy, Nov. 7, 1854; Meyer, Feb. 28, 1854; Fostrick, in 1856, with De Wolfe and Eaton, in 1859. In 1850 Trotter took out a patent for the use of zinc hyposulphite as a vulcanizing medium, using no free sulphur. Little is heard of rubber tires, however, until 1868, when we find a patent issued to C. K. Bradford, claimed by some to be the first rubber tires in the United States. In the same year, Dec. 15, J. A. Greene patented a flat strip of rubber bolted to the iron tire by bolts passing through the felloe and having springs on their nutted ends to take up the bolt movement as the rubber strip compressed.

Thompson's Solid Tires

Thompson, in England, seems to have continued his tire experiments along the line of solid tires, having failed to find a market for his aerials. In 1868 we find road steamers, a sort of light traction engine, giving good service on both sides of the water, fitted with Thompson tires, those on the drivers being a foot wide and 5 in. thick. These tires were watched with considerable interest and a set that had run 1200 miles are reported to have shown no symptoms of deterioration or decay. The Edinburgh *Scotsman* of that year speaks very enthusiastically of them and says "the application of vulcanized India rubber to the tires of road steamers forms the greatest step ever made in the use of steam on the common roads." Another British publication reports the road grip as marvelous, the riding smooth, with no jar, and the machinery spared. These remarks are interesting because they show that the destructive effects of road vibration on machinery were appreciated even with the heavy and clumsy construction of that time, and it is probable that this destructive effect was even more noticeable than to-day, because of poorer materials.

Prototype of Tire Chain

In the *Scientific American* for Sept. 24, 1870, the Thompson solid tires were described as being mounted on a broad rim with flanges, but the interesting part of this description was that over this tire was an endless chain of steel plates, connected together at each side of the wheel. No rigid connection is made with the wheel, but this chain of plates was free to move around the tire "as they please without consulting each other." Clearly, this was the predecessor of the modern tire chain, and the fact that there was much question as to traction ability and freedom from slipping, in wet spots, very plainly indicates that the anti-slip abilities of such a chain could not have been overlooked at that time even if the principal thought was to protect the rubber. That this latter was not the principal thought must be evident to anyone accustomed to the use of rubber tires, and it was undoubtedly well known in those days that metal, more or less loosely attached to rubber, quickly destroyed it.

That rubber was coming rapidly into use is shown by a report of 10,000,000 lb. in 1870 and a belief that the supply was inexhaustible.

$1,050 for a Set of Tires

In April, 1871, we find a further statement regarding the Thompson tires, the weight of a 6-ft. tire being given as 600 lb., which, at 2 shillings per pound, would make a set cost $1,050 in gold. The set mentioned had made 260 journeys of 7 miles each way, being loaded on the one to ten average up-grade direction, a total of 1820 miles, and their outsides were slightly marked, but the insides smooth. "Clams" of metal were attached to prevent slipping when needed. This description would indicate that these broad, flat bands of rubber were not cemented in place, but simply retained by the rim flanges. That they did not continue in use, and so are not mentioned in later publications, seems to indicate that their cost was prohibitive.

Rubber Segment Tires

U. S. Patent to L. W. Cheever, in February, 1869, shows a D-shaped rubber mounted in a rim that seems to have been produced by planing or milling a groove in a thick iron tire, this groove being slightly dove-tailed. It was presumably cemented in place, and having a flat base, should have carried light loads very satisfactorily. In 1870 we find tires consisting of rubber segments mounted on metal plates which were mechanically fastened to the wheel, a method employed by inventors thirty or more years later. The year 1871 shows a spring tire brought out by J. H. Clapham.

The Rostrum

A Formula for Computing Pulling Power

EDITOR THE AUTOMOBILE:—As a subscriber, I ask your consideration of the following method for computing the relative pulling power of various machines in high gear.

Multiply the engine displacement by the gear ratio and we have the number of cubic inches of gas fired during two revolutions of the rear wheels. Multiply twice the diameter of the rear wheel by 3.1416 and divide this into the product obtained above, and we have the maximum number of cubic inches of gas that can be fired in propelling the car 1 in. forward. Now, if we have the weight of the car in pounds, move the decimal point three places to the left and divide it into the above result, and it will give the number of cubic inches of gas the motor expends to the 1000 lb. when working to its full capacity.

Or briefly, $\frac{\text{ratio} \times \text{disp.}}{n \times 2 \text{ r. w. diam.}} \div \frac{\text{weight}}{1000}$ = cubic inches to 1000 lb.

If this is computed for several different machines it seems that the results would show the comparative power of each machine. Of if preferred, it might be more fair to add the weight of a passenger load to that of each machine. Of course different motors vary, so will you please state what factors enter to make these results less accurate, also whether you think this method worth any consideration at all.

Also will you please give the following information:

1—What was the gear ratio of the Hudson super six that made the twenty-four hour record at Sheepshead Bay?

2—What is the weight of the Hudson super six ready for the road?

3—Kindly publish the power curve of the Oakland model 6-32 motor, or if this is not available state at how many revolutions per minute it reaches the peak of its power curve.

4—What is the weight of the Moon model 30 ready for the road?

Plattsburg, Mo. C. E. J.

—As a method of comparison the plan you suggest is quite interesting as it incorporates both the considerations of volumetric efficiency and fuel economy. Of course we do not know exactly to what extent the cylinder is filled in every revolution. Therefore the results you obtain will not be exactly accurate as they must be multiplied by the volumetric efficiency factor, but taken for different cars your figure would be very interesting.

1—The gear ratio used in this endurance test and with which the records were made was 3½ to 1 in place of the standard 4 5/11 to 1.

The reasons for the selection of this particular gear ratio may be summed up in a few words. The trials were made to prove endurance. Speed was purely a secondary factor, although it was naturally due to the power developed in proportion to car weight. The object in making these tests for endurance was to prove that the super six motor would last longer under the greatest possible strain than other cars. In other words, to clip some time off previous records. It does not take 76 hp. to propel the super six, having a total weight of 3500 lb. at 65 m.p.h. Only about 50 hp. would be necessary. If, therefore, it had used the 4 5/11 gear ratio, the speed would have been limited to about 68 m.p.h. The car speed would have been limited by motor speed, not by the insufficiency of power. But to propel this car at an average speed of 75 m.p.h., 76 hp. is absolutely necessary. The main object of the test was, therefore, to develop 76 hp. under actual running conditions for 100 miles. The Hudson company states that it was not to create records for speed that it made these attempts at record-breaking, but rather to prove the endurance of the super six motor.

2—The weights of the super six models, complete with wood wheels, tools, extra rim, oil, gasoline and water, are as follows:

Model	Lb.	Model	Lb.
Phaeton	3365	Cabriolet.	3310
Roadster.	3170	Limousine	3750
Touring sedan	3600	Town car	3660

The car complete with wood wheels, but without tools, extra rim, gasoline or water, weighs as follows:

Model	Lb.	Model	Lb.
Phaeton.	3161	Cabriolet.	3106
Roadster.	2966	Limousine	3546
Touring sedan	3396	Town car	3456

3—The horsepower curve of the Oakland 6-32 is not available. Its peak is reached at 2650 r.p.m.

4—The weight of the Moon 6-30, as given by the manufacturer, is 2750 lb. ready for the road. This includes an extra casing.

Use of Two Storage Batteries

Editor THE AUTOMOBILE:—Would it be advisable to install a separate storage battery to be used exclusively for either lighting or starting the type 53 Cadillac car? Also advise how regulation of charging apparatus should be worked out, so that either battery would not become overcharged.

Huntington, Pa. F. B. P.

—A single battery can be used for both starting and lighting provided it is designed for the purpose. Regulation of the charging apparatus depends upon the type of generator and if you are buying a generator, this is generally incorporated with it.

Rebuilding 1908 Packard as Raceabout

EDITOR THE AUTOMOBILE:—The above illustrations, Fig 1, show what can be done with an ordinary stock chassis in the way of turning it into a raceabout. I have seen several inquiries in your magazine as to the advisability of making such a car and think, therefore, this might be of some interest to your readers.

The car is a 1908 Packard runabout. The main changes, such as the body, wire wheels and the dropped gas tank, are quite evident from the photographs. Otherwise about the only real change is the fitting of aluminum alloy pistons and a racing type Master carbureter.

I dropped the gas tank and put smaller wheels on the car to make it hold the road better and now, owing to the light body and the aluminum pistons I have gotten it up higher

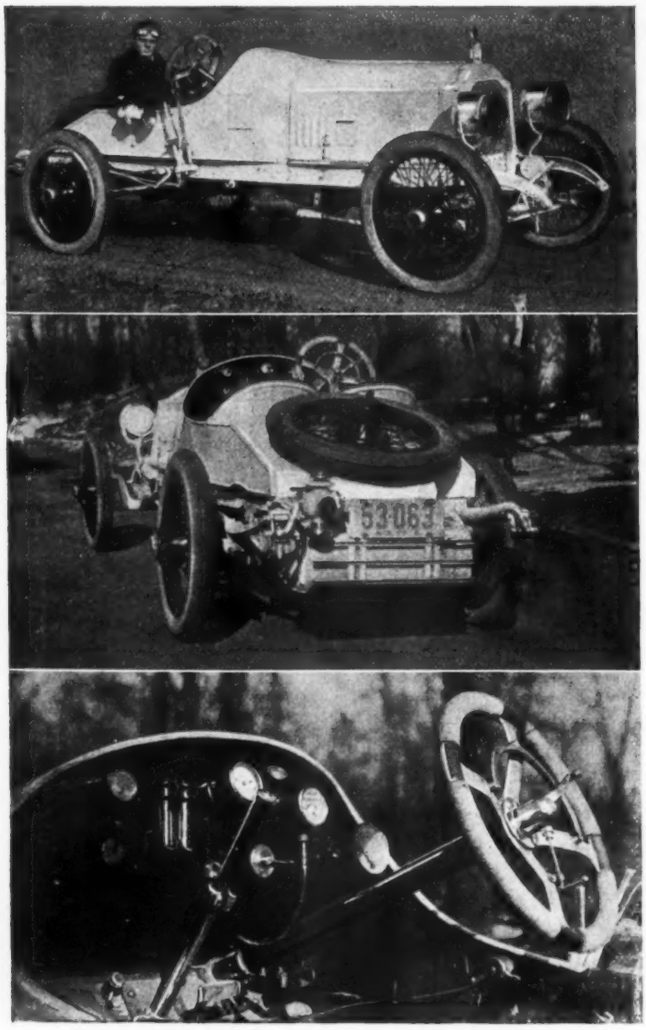


Fig. 1—Two views and a glimpse of the instrument board of a 1908 Packard runabout converted into a raceabout by a reader

than 80 m.p.h. and it holds the road perfectly. It will also beat any car I have ever seen on hills.

The price of a job of this kind would, of course, vary, depending on how far it was carried out, but the body work and wire wheels would cost about $400. This includes dropping the steering wheel and gas tank.

New York City. J. B. T., Jr.

Aluminum Pistons for High Speeds

Editor The Automobile:—When using oversize tires is it necessary to change the speedometer gearing in order to obtain a correct reading?

2—Would it be advantageous to fit aluminum pistons to such cars as the Dodge, Overland, or cars having pistons of more than 3½-in. diameter?

3—Where does the Willys-Knight use Timken bearings?

4—In order to manufacture a motor embodying the Knight sleeve valves, what are the requisites as regards royalties on the invention?

5—What is the principle of the vaporizing plug manufactured by the Detroit Carbureter Co.?

Ponce, P. R. E. T.

—Yes.

2—If you desire to make extremely high speed it would be advantageous.

3—Both front and rear wheel bearings are Timken and also the differential end of the rear axle shaft.

4—This is a matter which must be arranged with the Knight & Kilbourne Patent Co., Chicago, Ill.

5—The vapor plug is so arranged as to admit additional air to the intake.

13% Use Valve-in-Head Motors

Editor The Automobile:—How many 1916 model cars use valve-in-head motors?

2—Is this type of motor gaining any favor in this country?

3—Are all racers valve-in-head?

4—How many makes of car motors are built in the U. S.?

Upland, Neb. H. D. L.

—The number of 1916 model cars using valve-in-head motors is twenty-three. This is 13 per cent of the number of chassis regularly listed.

2—This type is regaining its lost prominence. In 1910 18 per cent of the chassis had I-head motors. This gradually dropped until in the years of 1912 and 1913 it was down to 9 per cent. The lowest point was reached in 1914 when it was 6 per cent. It has been steadily increasing since, being 8.5 per cent in 1915 and 13 per cent for 1916.

3—No.

4—The number of car manufacturers making 1916 cars is about 125.

Various Gear Ratios for Blitzen Benz

Editor The Automobile:—What are the gear ratios of the Blitzen Benz recently purchased by H. S. Harkness?

2—How many speeds has this car?

3—How many cylinders?

4—What is the bore and stroke?

5—Does the Duesenberg company manufacture a passenger car or are its activities confined to racing?

6—What is the bore and stroke of the Duesenberg motor? Also the gear ratios?

Ithaca, N. Y. F. S. W., Jr.

—There are numerous gear ratios used on this car to accommodate it to the track upon which it is running.

2—Three speeds.

3—Four cylinders.

4—The bore is 185 mm. and the stroke 200 mm.

5—Other motors are also built.

6—The bore is 3¾ and the stroke 6¾. The gear ratio is different on the different Duesenberg cars, but is generally a little over 3 to 1.

Cadillac Switch Lock for Protection

Editor The Automobile:—For the benefit of all drivers of 1916 Cadillac cars tell us how one can start the motor if he should have his switch locked and forget his keys.

2—Publish name and address of some firm where I could get a book on the 1916 Cadillac Delco system.

3—Please explain the action of the timer on 1916 Cadillac.

4—If a twin six crankshaft is making 3000 r.p.m. how many sparks take place in that minute? Please explain.

5—What is meant by the tread of a machine?

6—If you had a tire without a size marked on it how would you proceed to tell the size?

7—How much clearance is there between head and top of the cylinder on the 1916 Cadillac?

Brooklyn, N. Y. H. B.

—Publishing this information would deprive all Cadillac drivers of the benefit of their switch locks.

2—The Cadillac instruction book goes into the adjustments of the Cadillac Delco system quite fully. Further information, however, can be obtained from the Dayton Engineering Laboratories Co., Dayton, Ohio.

3—The timer on the type 53 Cadillac is fitted with two sets of contact points connected in series, the object being to distribute over two sets of points the current which would other-

wise pass through one set, which cuts down burning of the points and makes frequent adjustments unnecessary.

4—If a twin six crankshaft is making 3000 r.p.m. 18,000 sparks are being delivered in 1 min. This is readily explained by the fact that on any four-cycle engine there are half as many sparks per revolution as there are cylinders, for the simple reason that each cylinder is exploded every other revolution. Hence, since there are twelve cylinders, there are six sparks per revolution, and at 3000 r.p.m. there are 18,000 sparks per minute.

5—The tread of a car is the distance transversely from the center of the tire contacts on the left side to the center of the tire contacts on the right side. The standard tread of an automobile is 56 in.

6—Measure the interior diameter from the point where the two beads come together up to the inside of the top of the tire. This will give the small dimension. The large diameter is obtained by adding twice this dimension to the diameter across the inside of the beads.

7—The clearance between the piston heads and the top of the cylinders on the type 53 Cadillac when the engine is on the upper stroke is approximately ½ in.

Diagram of Starter on Cartercar

Editor THE AUTOMOBILE:—Kindly print diagram of the Jesco starter No. 3 used on the Cartercar.

Humphreys, Mo. E. H. R.

—The diagram you desire is published herewith in Fig. 2.

Wants Information on Floating Axles

Editor THE AUTOMOBILE:—What style axle is most used, full floating or floating? What is the difference between these two?

2—Have they ever been discussed or has a description been published in these columns giving advantages and disadvantages? What issue?

3—What kind is used on the model 80 Overland?

4—Give good way to clean carbon out of the motor?

5—How can the radiator be cleaned without hurting the motor?

6—Why is the carbureter placed so low on the model 80 Overland? Is it not best to have it high so as to get a short manifold?

7—What are the advantages of the single cast cylinders over block cast cylinders or vice versa? Are the single hard to keep in line when overhauled?

8—How can I get the most speed out of the model 80 Overland? What speed should this car make?

9—What model carbureter is used? Has it a two-speed adjustment on it? How is it turned if more speed is desired, up or down?

Bouton, Iowa. C. M.

—The full floating and floating axles are identical. There is no difference between them.

2—A full description of the different types of axle and their advantages was given in THE AUTOMOBILE for Sept. 9, 1915.

3—The Overland car uses a floating type of axle.

4—A good method of removing carbon from a motor is by the oxygen process with which it is burned out or by scraping after removing the valve caps.

5—As has often been stated in THE AUTOMOBILE, a radiator can be cleaned out by using a saturated solution of hot water and common washing soda.

6—Regarding your inquiry as to why the carbureter is placed so low on the 80 Overland, would state that this is a question of individual design which can best be answered by the Overland company. Some makers believe in placing the carbureter very low in order to be sure of adequate gasoline flow.

7—The advantages and disadvantages of cylinder arrangement are largely concerned with economical manufacture. There is no difference in the difficulty of lining up the cylinders whether they are block cast or singly cast.

8—THE AUTOMOBILE has no record of the maximum speed which can be obtained with a model 80 Overland. To get this to its maximum the valve timing should be altered to give an early exhaust opening. Aluminum pistons can be fitted and the gear ratio changed to nearer direct.

9—Several makes of carbureters were fitted to the model 80 Overland. The carbureter generally used had a hot air attachment and only one adjustment.

Car Harder to Start with Naphtha

Editor THE AUTOMOBILE:—Will naphtha injure the motor of an automobile, and is there any objection to using it? My neighbor drained the gasoline out of his car and put in a gallon of naphtha and it seemed to work all right and even seemed to have more power; it tests 52.

Moline, Ill. A. V. B.

—There is no definite distinction between gasoline and naphtha. If you are using 52 gravity fuel it will work out successfully, only it will be more difficult to start. There is more power in 52 fuel than there is in the 60 because it has more thermal units to the pound.

Correct Gearing for Warner Autometer

EDITOR THE AUTOMOBILE:—What is the correct number of teeth in road wheel gear and driven gear to give correct mileage and indicate correct speed at which the car is moving when using a Warner autometer, size of wheels being 37 by 4½?

Morenci, Mich. F. D. K.

—To insure correct indication of a Warner autometer under the conditions you mention the drive gear should have seventy-five teeth and the driven gear twenty-nine teeth, or the ratio should be equivalent.

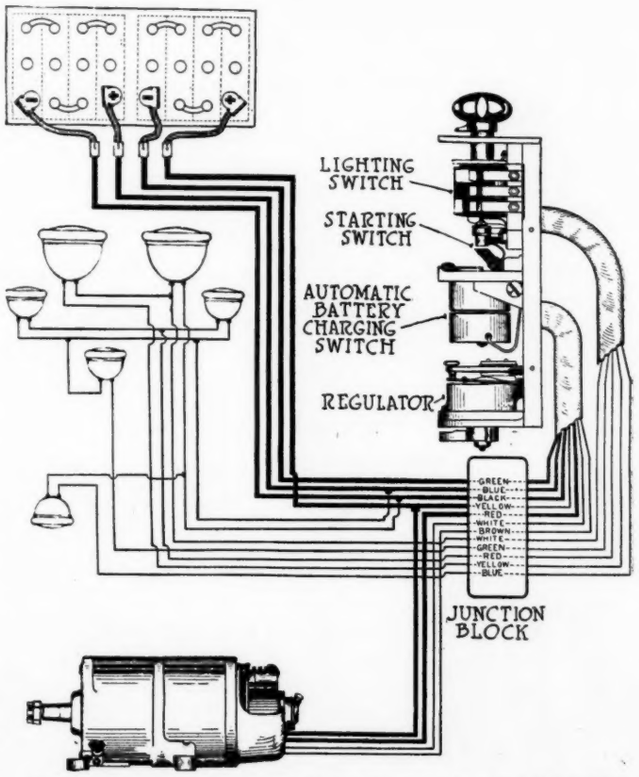


Fig. 2—Diagram of the Jesco starter No. 3 used on the Cartercar

ACCESSORIES

Truck Attachment for Fords

THIS is a truck unit for Ford cars which follows closely the scheme of attachment and drive that has been worked out in a number of instances. The auxiliary truck frame is arranged to slip over the regular Ford frame, and when in position the Ford rear axle becomes the jackshaft, driving sprockets being attached to the axle shafts in place of the regular Ford wheels. It is said to be a very easy matter to attach the unit and requires the drilling of only a few holes in the regular Ford frame in order to bolt the front end of the truck frame in place. Suspension of the truck frame from the auxiliary truck axle is by three-point platform construction, so arranged that the rear cross spring acts as an auxiliary when carrying a light load up to 500 lb. For loads above that amount the weight is transferred to the side springs. The frame has a 4-in. depth of channel with a 2½-in. channel width and is made of 3/16 in. pressed steel. Timken bearings are carried in the truck wheels and the drive is transmitted through Covert & Taylor chains.

The truck unit gives the Ford a rated capacity of 2000 lb., although it is said to be capable of a 50-per cent overload. The wheelbase is 135 in., and the rear wheels measure 32 by 4 in., being fitted with Firestone solid tires. The service brakes are on the rear wheel drums and are controlled by rods running forward, while the emergency brakes act upon the jackshaft. Substantial radius rods maintain proper alignment between driving sprockets and wheels, and the frame is substantially reinforced by diagonal cross pieces to assist the cross members. The unit is priced at $350, and where the Ford chassis is also furnished the total cost is $750.—Automobile Mfg. & Engineering Co., Detroit, Mich.

Water-Shed Windshield Paste

Water-Shed Paste is a compound applied to windshields to prevent water accumulating on the glass during stormy weather. A portion of the glass surface of a windshield may be rubbed with the paste and a cup of water thrown on it with the result that the glass will be free from drops or streaks of water where the paste was applied, while the surface near it ill be blurred. The paste is sold in tubes at 25 cents each.—C. O. Thomas Co., New York City.

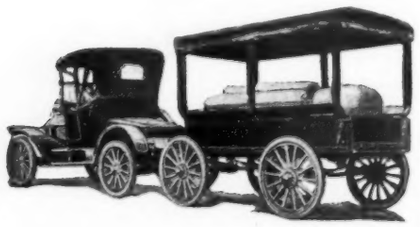
Trailmobile Trailer

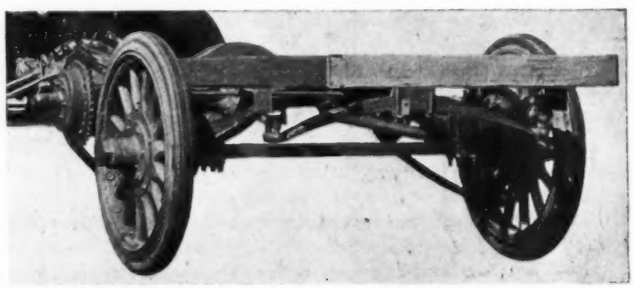
This trailer is made in two capacities, 1250 and 1500 lb. The wheels, of wood with solid rubber tires, run on roller bearings; the front wheels are mounted on knuckles of the automobile type connected by a drag link with the drawbar, so that the steering is the same as that of the car that pulls the trailer. All springs are semi-elliptics. The maker states that a fully-loaded trailer can easily be moved by hand. Coupling fixtures are supplied for various types of rear end construction, and a special type is made for Fords. The smaller chassis has a loading space of from 39 to 42 in. wide and 85 to 95 in. long, according to body; wheelbase, 62 in.; wheels, wood, with 32 by 2 truck-type tires; weight, 530 lb.

The larger chassis specifications are: Loading space, 40 to 42 in. wide and 95 to 100 in. long; wheelbase, 62 in.; wheels, wood; tires, 32 by 2 front, 34 by 2½ rear; weight, 570 lb. Both have standard tread. A spring shock absorbing device in the coupling system takes up shocks due to sudden starting and stopping, running in and out of pitchholes and the like. Practically any type of body can be had, open or inclosed. Prices, $208 to $300, according to type of body. Chassis only, 1250 lb. capacity, $179; 1500 lb., $209.—Sechler & Co., Cincinnati, Ohio.

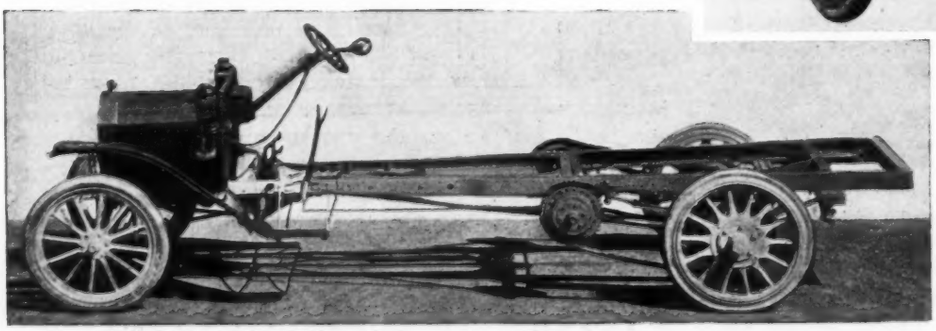
Low's 5-Min. Vulcanizer

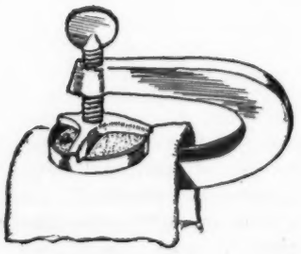
This vulcanizer is simply a screw clamp with a three-arm spider on the end of the screw. The patch is of pure gum rubber and comes set into the concave side of the metal pan; a rim around the pan forms a shallow cup on the side opposite to the patch, and in this cup is a disk of cardboard impregnated with a chemical substance which causes it to burn without flame and with exactly the amount of heat required to vulcanize the patch. Thus the patch mold and the fuel are combined in a unit; the metal pan is thrown away when a patch has been applied. To apply a patch the metal pan is clamped on the tube, rubber side next to the tube, the cardboard disk is lighted and allowed to burn out and the job is finished in 5 min. The gum rubber is liquefied by the heat and runs to a feather edge all round, making a permanent repair. Long rents in a tube can be repaired by applying a row of patches with overlapping edges. Price, with twelve patches, $2; extra patches, $1 per dozen.—5-Minute Vulcanizer & Auto Supply Co., Kansas City, Mo.





Left — Trailmobile trailer. Right—Rear view of truck attachment for Fords which is illustrated below. Lower right — Low's 5-min. vulcanizer





The Automobile

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The Differential

THE vigorous correspondence which has been taking place in the Forum proves the amount of thought that is being given to the improvement of the differential. Besides the letters published, we have received scores expressing interest and many which show that invention is active in this field. There are all sorts of alternatives to the standard form of differential and it seems likely there will soon be many more made public, which is another argument against the theory that the automobile has reached a stage of development nearing the final.

Transcontinental Racing

IN congratulating the Empire Company on the performance of its car in crossing the continent in record time, thus beating an almost equally remarkable record just made by a Cadillac, it is well to sound a note of warning. That these tests provide a magnificent demonstration of the strength of a car is undeniable. It would be hard to find any possible test in the world that means more, but sustained maximum possible speed on the road is not without its dangers to all road users. Thus it is to be hoped that the recent successful attempts will not set a fashion for records of this sort. If there are many such, it is only a matter of time before some less skillful driver overestimates his ability, or till some chance occurrence brings about disaster. Rather, if the public takes as much account of these demonstrations as it ought to do, such runs prove once more, if proof were needed, that there is everything in favor of stock car racing over a road course which can be properly cleared and guarded.

Picking a Winner

NEVER before has there been an Indianapolis race with so many possible winners in the field. Last year was thought to be difficult to forecast, but this year the result of next Tuesday's race is harder than ever to guess. There is a big field of cars which are known to be in good condition, with drivers of known ability. There are some newcomers who may prove as sensational as did the Stutz team last year; there is a less prominent "tail" of cars which have not a chance to win, barring the most extraordinary events.

Thus visitors to Indianapolis are assured of seeing an extremely fine race. It cannot be a walk-over for anyone and several can fall by the way still leaving sufficient first rank cars to make a magnificent struggle. Seldom if ever has there been a race which promised better from the spectacular viewpoint.

Horsepower Rating

ALL over the world where automobiles are used in any quantity, there is need for some sensible method of comparing their power. For taxation in some countries, for competition rating, for insurance rating and for many other reasons a good formula is needed.

A few years ago in England a highly scientific committee was appointed to work out an answer to the problem and they evolved a formula of great complexity. It gave good results but almost needed a sliderule and a book of logarithims to apply.

Now, there is no simpler rating than that of piston displacement, used universally for racing limitation of power. Different motors have different degrees of volumetric efficiency, but it is not difficult to pick out a definite volume and to say that an average engine ought to give one horsepower for this volume.

Somewhere between 5 and 7 cu. in. per horsepower is normal. It is a poor engine that will not give a horsepower for every 7 cu. in. and a good one that betters 5. Why cannot the S. A. E. and the N. A. C. C. give the world a lead by making America the first nation to adopt, and use, a sensible method of comparing the power of conventional cars?

The adoption by America of some simple method of rating which would be better than the obsolete A.L.A.M. formula would be likely to lead to an international system. At present England and America both use the same formula when they use any formula whatever. If America were to adopt the assumption that normal engine power could be represented by dividing the piston displacement by six, this would fit in well with the metric system, as 6 cu. in. is almost exactly 100 cu. cm. Thus an engine could be measured in either inches or millimeters and the power would work out almost the same.

Federal Reciprocity in Sight

Adamson Bill, Which Provides for a Single Car Tax, Favorably Reported

WASHINGTON, D. C., May 20—The Adamson bill, providing that no automobile owner licensed in one State, district or territory, shall be required to take out a license or pay an automobile tax of any kind in any other State, district or territory was ordered favorably reported to-day by the House Committee on Interstate and Foreign Commerce. It is expected the bill will be enacted into law within the next few weeks, as strong pressure is being brought to bear upon members to this end.

—

Maxwell to Share Profits

DETROIT, MICH., May 20—Employees of the Maxwell Motor Co. are to become beneficiaries of the company, in a profit-sharing system, which is to take the form of a substantial bonus at the end of the year.

Directors of the Maxwell company at a recent meeting gave approval to a resolution providing for inauguration of the bonus system at the end of the year. Details of the plan have not yet been announced, but it is understood the payments will be in the form of a specified amount to each employee.

—

Nones Elected Norma President

NEW YORK CITY, May 19—W. M. Nones has been elected president and treasurer of the Norma Co. of America. Mr. Nones was secretary-treasurer, as well as general manager.

—

Link Is Redden Consulting Engineer

DETROIT, MICH., May 19—Vincent Link, formerly chief engineer of the Universal Motor Truck Co., has been engaged as consulting engineer of the Redden Motor Truck Co.

—

Scripps-Booth Occupies Addition

DETROIT, MICH., May 22—The addition to the Scripps-Booth factory, which will enable the company to double production, was occupied for the first time to-day, having just been completed and equipped with the necessary machinery.

James Dugan has been promoted from the position of factory superintendent to production manager. T. M. Rude, who is in charge of follow-up work, has also been placed in charge of purchasing.

—

Oggel in Charge of Purchasing

KALAMAZOO, MICH., May 18—P. H. Oggel has taken charge of the purchasing department of the Fuller & Sons Mfg. Co., this city. G. W. Fuller is now connected with the sales department of that company.

The company has been running day and night since last October and will probably continue this schedule for the balance of the year. Two new buildings have been erected and plans are being made for further additions.

—

Winton Doubles Output

CLEVELAND, OHIO, May 22—The Winton Motor Car Co., this city, like the majority of other automobile manufacturers, is feeling the effects of the greatly increased demand. Having an output of from 1200 to 1500 cars per year the present indication is that at least 4000 of the two present models will have to be made to satisfy demands. Consequently, the plant is rushed to the limit of its capacity and the floorspace has been augmented by the erection of some large tents on an adjoining lot.

—

Decision in Spark Plug Suit

NEW YORK CITY, May 24—A. R. Mosler & Co. and the Benford Mfg. Co., are enjoined from selling their Ford plugs as now organized, according to a decision of Judge Hand in the U. S. district court, in the case of the Champion Spark Plug Co. against the two defendants, charging unfair competition in the sale of spark plugs resembling its model Champion X used on Ford cars.

In the case of the Mosler company which makes the Mosler Superior plug for Fords, this company will be enjoined from selling this plug unless it changes the color of the shell and bushing nut, and of the porcelain, so as to distinguish their appearance. The name Mosler must be retained, and in the case of plugs made for jobbers, the name of the jobber or some trade mark in letters other than red which shall be unlike Champion X.

The same decision applies to the Benford company, except that an injunction also stands against the use of the name Ford and the symbol Ford X on its plugs.

—

Eustis Joins Chevrolet Co.

NEW YORK CITY, May 23—After being motor truck editor of *The Evening Mail* for 5 years, John R. Eustis has resigned to become advertising manager of the Chevrolet Motor Co. Mr. Eustis was formerly automobile editor of the *Brooklyn Daily Eagle* and the New York *Globe*.

—

Hinkley to Direct Purchases

JACKSON, MICH., May 18—Burton C. Hinkley, former purchasing agent for the old Argo company, has been appointed director of purchasing for the Argo Motor Co.

A. A. A. Favors Single Car Tax

Advocates Adamson Bill at Annual Meeting—Dr. Rowe Elected President

WASHINGTON, D. C., May 20—At the annual meeting of the American Automobile Assn., held yesterday at the Hotel Willard, Dr. H. M. Rowe of Baltimore was elected president. Other officers are: Vice-Presidents, Ralph W. Smith, Colorado; P. J. Walker, California; H. J. Clark, Minnesota; Preston Belvin, Virginia; David Jameson, Pennsylvania; C. C. James, Ohio; treasurer, H. A. Bonnell, New Jersey; secretary, John N. Brooks, Connecticut. While the chairmen of the various boards have not been selected, it is understood the present chairmen will be continued in office.

The meeting was opened by President John A. Wilson, whose annual report was unanimously adopted by the 200 delegates in attendance.

Richard Kennerdell, chairman of the contest board, told of the work accomplished by this important committee and how motor competition had been kept on a high plane. George C. Diehl, chairman of the good roads committee presented a brief report on the work of the committee during the year and aroused much enthusiasm with his reference to the passage by Congress of a $75,000,000 good roads bill.

E. L. Ferguson, in the absence of David G. Joyce, chairman of the touring committee, explained the route and map work of that branch of the association during the past year. He pointed out that as a result of travel in this country last year 150,000 tourists invaded New York State, spending approximately $15,000,000. New Jersey, he said, fell behind in this respect, while New York and New England forged ahead. Between $16,000,000 and $35,000,000 was spent in New England.

The report of H. A. Bonnell, treasurer, showed the association to be in the best financial condition in its history. Richard H. Lee, chairman of the legislative board, told of the efforts that have been and are now being made to discourage motorists generally from joining so-called bargain organizations.

Resolutions were passed calling for uniform regulation for all types of vehicles and for single taxation for the automobile; for the abolition of fees required for drivers' licenses; for the reduction of the registration fee in States where a personal tax is levied to cover only the cost of such registration; for the passage of the so-called Adamson bill; and for equal rights for all vehicles on public highways.

Empire Four Sets New Record

Transcontinental Trip of 3485 Miles in 6 Days, 10 Hr. and 59 Min.

NEW YORK CITY, May 23—A new transcontinental record of 6 days, 10 hr. and 59 min. for a distance of 3485 miles has been set up by a stock Empire four, driven by Robert Hammond. The old record of 7 days, 11 hr. and 52 min. for a distance of 3380 miles was established the very day that Hammond and his Empire started out from San Francisco, this being May 17. When Baker and Sturm in the Cadillac eight reached this city after their record-breaking trip, they little thought that that record would be shattered in so short a time.

Hammond, who averaged 22½ m.p.h., followed the Lincoln Highway, starting at San Francisco, through Oakland, Truckee, Ogden, Cheyenne, Omaha, Clinton, Ill., Fort Wayne, Ind., Lima, Ohio, Pittsburgh, Philadelphia and New York City.

His longest run was between 'Frisco and Ogden, a distance of 917 miles, which was negotiated in 36 hr. He arrived at Omaha May 20, and after a run of 700 miles in 17 hr., reached Elkhart late Saturday evening, where he had his first rest of 10 hr.

At the start Hammond ran into a deep coat of snow on the roads over the Sierras, but overcame this obstacle by following a train through a snowshed for about 40 miles. Owing to this maneuver, he was able to make his long run to Ogden in 36 hr. Near Cheyenne, Wyo., the car hit a thank-you-ma'am at 45 m.p.h., and Harold Bell, the passenger, was thrown out, landing 25 ft. away with an injured arm. Hammond drove alone from there to Ft. Wayne, where he picked up Herbert Wasson, from the Empire factory.

2 M.P.H. at Canton

At Canton, Ohio, the previously good weather changed to rain squalls and the car crawled through the mud at 2 m.p.h. After colliding head-on near Pittsburgh with an automobilist who got in the way at the cost of a front wheel, the car was ditched in the Blue Ridge mountains. At this point the only tire-casing change necessary was made. Seventy punctures in all occurred during the trip. Gasoline consumption averaged 10 to 13 m.p.g. and a gal. of oil was used every 150 miles.

Hammond went the whole distance without touching the motor or spark plugs. He managed to avoid being arrested up to Newark, N. J., where he was stopped for reckless driving and fined $20. Threat of further police interference held him down to a slow pace all the way into New York, which he reached at 1.49 p. m. to-day.

Hammond, who will go after new records in the near future, will be remembered for his tour of the world in an automobile several years ago. He was the first to climb the Alps in a car and was one of the drivers of the New York to Paris race, which was won by the Thomas. One of his achievements was a drive of 3 days and 2 nights in an endurance contest on a dirt track. In that event he succeeded in going the full distance without leaving the car seat. In his latest transcontinental trip his sleep amounted to between 11 and 12 hr.

The following table gives the runs between the stopping stations:

San Francisco to Ogden	917
Cheyenne	317
Omaha	551
Elkhart	650
Ft. Wayne	64
Canton	222
New Oxford, Pa.	293
Philadelphia	109
New York City	100

The mileage of the route followed is:

San Francisco to Truckee	252
To Reno	35
To Austin	188
To Ogden	442
To Lyman	124
To Cheyenne	354
To Fremont	516
To Omaha	35
To Jefferson	136
To Clinton	250
To Elkhart	264
To Ft. Wayne	64
To Lima	64
To Bucyrus	65
To Canton	93
To Pittsburgh	106
To Philadelphia	296
To New York City	100

The car was equipped with Horseshoe tires, Bales puncture pluggers, Prest-O-Lite tank, Stewart-Warner speedometer and vacuum feed, Rex spark plugs, Pyrene fire extinguishers and Auto-Lite electric system.

—

Strong Succeeds Collins as Buick General Sales Manager

FLINT, MICH., May 22—E. A. Strong, formerly manager of the Chicago branch of the Buick Motor Co., has been appointed general sales manager of the parent Buick organization to succeed R. H. Collins, resigned. Strong has been connected with the Buick organization since 1911, and previous to that was identified with the McCormick Harvesting Machine Co. and later with the International Harvester Co.

Strong's first connection with the Buick company was as branch manager at Buffalo. He held that position for a year and then was Indianapolis branch manager for 2 years, after which he went to Chicago. Collins does not officially relinquish his duty until the end of the company's fiscal year, Aug. 1, but it is understood that Strong will take up the active management soon. D. A. Burke, now in the sales department of the Buick company, succeeds Strong at Chicago.

Indiana S. A. E. Plan Preparedness

Howard E. Coffin to Address Meeting at Dinner Given by Section to Council

INDIANAPOLIS, IND., May 22—The Indiana section of the Society of the Automobile Engineers will give a dinner at 7.15 in the Claypool Hotel, Monday evening, May 29, to the members of the council of the Society. The chief discussion of the evening will be on Industrial Preparedness and Howard E. Coffin (vice-president the Hudson Motor Car Co.), chairman of the committee on production, organization, manufacture and standardization of the Naval Consulting Board, will be the chief speaker.

This banquet will mark the closing of the 1915-16 meetings of the Indiana section which have been most successful. Plates are $2.50 each and accommodations can be secured from R. H. Combs, of the Prest-O-Lite Co.

The occasion is of some importance, as it will mark the first address of Mr. Coffin to the automobile industry, since he took upon his shoulders the bulk of the work of the industrial preparedness scheme. Briefly, the desire of those responsible for the scheme is to put America in such a position that in the event of war she can avoid Europe's errors.

—

Program of Papers for S. A. E. Summer Meeting Is Complete

NEW YORK CITY, May 24—The program of papers for the summer meeting of the Society of Automobile Engineers, to be held on the steamship Noronic on the Great Lakes, June 12-16, has been completed and comprises reviews of twenty-one pertinent subjects, as follows:

Future Scientific Development of the Automobile—C. F. Kettering.
Large Single vs. Dual Tires for Truck Rear Wheels—W. H. Allen.
Farm Tractors—C. M. Eason.
Motors for Trucks and Tractors—H. L. Horning.
Refinements and Generalities in Truck Design—H. D. Church.
Truck Subject—B. B. Bachman.
The Differential and Its Substitutes—D. D. Ormsby.
Motor Fuels of the Next Decade—W. F. Rittman.
Kerosene vs. Gasoline in Standard Automobile Engines—Prof. E. Lucke.
Pressed Steel in Automobile Construction—E. A. Nelson.
Crystallization in Cold Drawn and Pressed Steel Parts—R. H. Sherry.
Dynamics of Vehicle Suspensions—Benj. Liebowitz.
Straight Side vs. Clincher Type Pneumatic Tires—J. E. Hale.
Bronze Alloys for Motor Cars—W. M. Corse.
High Speed Motors—A. P. Brush.
Possibilities of the Constant Pressure Cycle Engine—A. B. Browne and Herbert Chase.
Car Performance—Prof. D. L. Gallup.
Recent Aeroplane Engine Developments—Neil MacCoull.
The Automobile Engineer and Preparedness—Howard E. Coffin.
Mechanical Transport Mobilization—A. J. Slade.
Automobile Experience in the Great War—W. F. Bradley.

Conditions Determine to What Extent Car Builders Shall Make Parts

H. M. Jewett, Paige-Detroit President, Tells Detroit S. A. E. That There Is No Uniformity About the Question, Each Manufacturer Being Guided by His Experience

DETROIT, MICH., May 18—In answer to the questions: Should a car manufacturer make his parts, or should he assemble them, and if he should manufacture them, what proportion should he make and which should he buy? H. M. Jewett, president of the Paige-Detroit Motor Car Co., told the large attendance at to-night's regular monthly meeting of the Detroit Section of the Society of Automobile Engineers that it is all a case of the individual conditions with each company. Through the particular experiences and troubles each maker has encountered, each has his own ideas of what he should and should not buy from the parts makers, and there is no uniformity about it. One large producer may make some part that another concern equally big has always purchased from a parts manufacturer, and there are so many qualifying conditions that no rules can be laid down. It is a safe prediction, however, that each maker has good and sufficient reason for the policy he follows. There are reasons back of each move he makes.

D. McCall White in Chair

The meeting was the first under the régime of D. McCall White, Cadillac chief engineer, who was elected chairman of the section at the April meeting. In taking the chair for the first time, Mr. White praised the work of the retiring officers and bespoke the hearty co-operation of all in carrying on what has already been accomplished. Because all cannot avail themselves of the annual midsummer outing of the entire society, which this year takes the form of a lake trip, it has been decided to hold a family outing for the section on June 24 somewhere in the vicinity of Detroit.

That the subject of assembly versus manufacture is of great interest to manufacturers was evidenced from the fact that some of the leading factory representatives entered into the interesting discussion that followed Mr. Jewett's talk. Among the speakers were Alvan Macauley, Packard; C. T. Meyers, Timken; K. W. Zimmerschied, General Motors; G. W. Dunham; W. A. Brush; J. W. Wright, Golden, Belknap & Swartz; J. G. Vincent, Packard; T. P. Chase, King; E. V. Rippingille, Hudson, and others.

Each manufacturer can take his particular viewpoint on the subject of manufacture versus assembly from his own personal experience in the business, Mr. Jewett stated. He divided the subject into four parts: first, the manufacturer producing a high-priced car costing $3,000 or over, in limited quantities; second, the volume producer making 10,000 machines or more; third, the maker that is forced into the manufacture of certain parts through business necessity; fourth, the parts that are seldom manufactured by the automobile company.

Price the Main Factor

Taking up the first of these, naturally the high-priced cars are produced in limited quantities, and the result is that in order to get high price, the machine must have extreme individuality. The maker of that car must really make practically everything there is in it, for the purchaser of a high-priced car has to feel that he is getting the worth of his money. The automobile maker in that class can ill afford, according to Mr. Jewett, to buy axles, engines, bodies, frames, wheels, etc., from parts manufacturers, because the latter are producing parts for cars in volume business, and it would be very difficult, from a sales standpoint, to convince the car buyer that such parts are any better than the ones made for the volume producer. This is especially true because the volume producer is advertising that on account of his quantity he can buy cheaper, so naturally, with his limited output, the high-priced maker would have that argument to face.

Going to the second division—the volume producer—there is great opportunity for diversity of opinion here. It is a common supposition that a manufacturer producing over 10,000 units can make his parts cheaper, said Mr. Jewett, but he questioned if that is entirely true, mentioning some conflicting policies of big makers to show that all do not hold any unified view of the matter. He showed where Overland, for instance, buys certain parts; he cited some of the Buick company's units that are made outside its plants; he called attention to Studebaker's purchasing certain things; mentioned other plants in a very frank manner, and gave it as his opinion that conditions altered cases and that there were good reasons back of each policy.

Many of the accessory makers themselves are not making every part. They assemble too, Mr. Jewett explained. A great many of the axle companies to-day are buying the gears that go into their units; gearset makers do the same thing, buying gears and malleables and machining and assembling them.

But there are certain things that manufacturers very seldom make. Bearings are one. Usually these are patented processes, require intricate and costly machinery, and a car maker can go out and purchase a bearing from a firm making a specialty of this part and secure a better bearing and cheaper than it could be made by the car plant. This example holds good for a great many of the parts that are seldom made by the car factory. Steering gears are another thing seldom made by the car factory; frames might come under this class also.

The machinery often required for the making of certain parts would not be economical for a great many manufacturers of cars to install. Take, for instance, rear axle housings. A press to do this would be capable of such large production that unless the maker were a very large producer the press would lie idle practically three-quarters of the year, which is not economy.

Manufacturers have two ways of looking at the condition. One spends a great deal of money telling the public that he is an assembler; another that he makes everything in his cars.

As an illustration of peculiar conditions that are to be found in each individual plant, Mr. Jewett told of walking through a purely assembly plant one day and noticing that they were enamelling fenders. He asked why this was done, since no other part of the car was manufactured. The reply of the superintendent was that they could not get the fenders enamelled well enough outside. This suggests the thought as to why others are not enamelling them for the same reason. Very possibly those others that are not enamelling them are having very good success with fenders they buy already enamelled. That is the only answer, because if all were having trouble in getting deliveries on properly enamelled fenders, they would all have enamelling plants the same as this particular case.

This leads to a consideration of the manufacturer who is forced to make his parts. Wherever a maker makes his own parts there is a substantial reason why he spends his money in machinery, tools, equipment and material instead of buying the unit. According to Mr. Jewett, you will find generally that each part that a manufacturer produces himself results from not being able to get deliveries or a fair price from the parts maker or through not being able to get this part good enough. He may not wish to buy a standard motor because that engine may be used by several different makers of cars selling at various prices.

The amount of capital needed to make cars outright is another consideration.

Where the maker buys from a parts producer the latter's capital is being used in the business, and just as long as the car maker can buy those parts as good as he thinks they ought to be and at a right price, Mr. Jewett does not think any car maker is going to get into the the parts making business. However, the motor is the most logical thing to produce, it being the most important part of the car.

The Paige president paid tribute to the brains of the S.A.E. that have made possible the interchange of parts of standard design through standardization.

Opening the Discussion

In opening the discussion Mr. White commented that in one particular price class the reason why manufacturers make a great many of their parts is because of class individuality. Another is the refinement of workmanship. Special conditions of silence, durability and workmanship dictate the individual manufacture of special parts. Then there is the matter of quality of material, which the individual maker can insure if he makes his own parts.

The chairman said further that in another class, in quantity production, where they have to buy parts, they have trouble due to lack of material. Sometimes there is practically only one part maker making a particular thing, and these concerns may be so full of orders that they are incapable of producing parts having special refinements. There is also the matter of prices which certain parts makers charge. In making special things, parts concerns are often confronted with the lack of floor space, and sometimes for financial reasons they simply cannot afford to lay down the special equipment necessary.

Taking up the discussion, Mr. Zimmerschied said:

"I have been very much interested in Mr. Jewett's exposition of this subject, and I know that the engineers can profit greatly by it, because he has given us a business view of it; and if there is anything that most of us engineers need, it is a little glimpse of the business side once in a while. At the same time we like to draw pictures and look at diagrams and curves, and perhaps I can organize the thoughts I have in my mind if I draw such a chart.

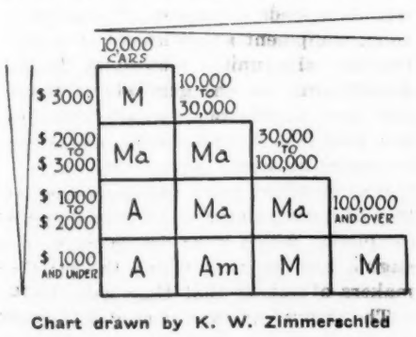

Chart drawn by K. W. Zimmerschied

"To my mind, the automobile industry can be subdivided in two ways, a sort of dual classification. First, quantity, and second, price; something like the illustration. Quantities up to 10,000 cars, in the first class. From 10,000 to 30,000 is what you might call the medium quantity production. Thirty thousand to 100,000 cars is the fairly large production, and the 100,000 plus is the super-quantity production class, you might call it. Then down the other way we will start with $3,000 and up, $2,000 to $3,000, $1,000 to $2,000, and under $1,000. Now, we find, if we go to cross-section all this area, that we would not be able to fill in all these spaces, because the $3,000 class never rises above 10,000 a year; so we have a square for that class that never will get higher in production. However, the $2,000 to $3,000 class will run over here into the 10,000 to 30,000 per year. The $1,000 to $2,000 might run over into the 30,000 to 100,000, and in the $1,000 down we run out into the 100,000 plus. So that that covers practically the field of all our automobile endeavor.

"Now, if we plot the tendency toward the manufacture of his own parts, we would find, as Mr. Jewett has said, that in the $3,000 class, that is the maximum, because the manufacturer wants the extreme of individuality; so we will draw here a wedge, running to practically zero at the bottom, the thickness of that wedge at any point indicating the tendency toward manufacturing his own parts which the manufacturer in that class follows. And in the same way we find another wedge, running out this way, which would indicate the pull on the manufacturer to make his own parts, on account of quantity.

"Now, in any one of these squares, it is evident that the summation of these two tendencies, and these two bases, would be in the $3,000 class, to manufacture all the parts. We will see here, more than in this case of maximum production, a maximum cheapness to manufacture all the parts. We might find very largely the same tendency here, and a similar tendency toward assembly; so I will introduce two small a's. Maximum tendency to manufacture, but on account of this component, a small tendency toward assembly. Why? On account of these two, it is all assembly, small quantity, small price. They have not the capital, they have not the draw to manufacture the parts.

"Now, then, suppose a group of men are going to start manufacturing an automobile. They think it is a good field to go into, and they are going to market the product. Following the line of least resistance, they would start in some of these classes here to manufacture a conventional product, which has a steady market, buying most of their parts outside. In trying to sell that product, however, they find at the end of the second or third year that they are not getting along very fast, because they have not this individuality which sells. They have got a lot of parts, a lot of manufacturers, and they are very much like their neighbors' cars; so in order to gain an influential position in the industry, they have either the choice of going up in price and getting into the individualistic class there, or else going out the other way and getting a large volume, and larger profits, without necessarily sacrificing individuality. But you notice it is always a question of individuality, if you are going to establish, to attain a position in the business, an influential position.

"Now, on the position of the parts manufacturer, I think that we owe a great tribute to the parts manufacturers for a great many of our big advances. The old saying that 'necessity is the mother of invention' is not so true, to my mind, as that 'competition is the mother of invention.'"

Cleveland S. A. E. Talks Efficiency

A. L. Clayden Presents Paper on Universal Joints at Season's Closing Session

CLEVELAND, OHIO, May 20—Last night night in the ballroom of the Statler Hotel the Cleveland section of the Society of Automobile Engineers held their concluding meeting of the season.

A. Ludlow Clayden, chairman of the Standards Committee, talked extemporaneously on the subject of efficiency, pointing out that the effieciency of an automobile in the widest possible sense was liable to be neglected when considering the efficiency of parts of it. He drew attention to the fact that a motor bicycle weighs little more than the load it carries, whereas a touring car often weighs seven or eight times as much as its load. Mr. Clayden said that it was often assumed automobile development was nearly complete. With this view he wished to disagree entirely because if the automobile had been developed to the limit of the present style of construction it was still a very long way from the fulfillment of ideals.

There was a short discussion and later Mr. Clayden presented his paper on universal joints, reprinted on page 934.

Following the reading of the paper there was a good discussion in which several members recited their experiences with joints made from flexible material. It appeared the results so far have not been very encouraging.

Following the precedent established by the Cleveland section the meeting was preceded by a dinner at which about eighty members were present.

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Pa. S. A. E. Holds First Picnic

PHILADELPHIA, PA., May 20—The Pennsylvania Section of the Society of Automobile Engineers held its first annual picnic to-day. Thirty members from all parts of the State attended the outing to Browns Mill, N. J., a drive of 35 miles. Canoe races, quoits, bowling and baseball were the main attractions of the day. J. W. Watson, president of the American Bronze Co., Berwyn, Pa., acted as chairman of the entertainment committee.

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Auto Kamp Equipment Co.

SAGINAW, MICH., May 17—The Auto Kamp Equipment Co., has been organized with a capital stock of $15,000. Automobiles, trailers, and other vehicles and appliances will be bought, sold and manufactured. The incorporators are C. W. McClure, Harry E. Oppenheimer, Allen D. Jackson and W. O. Sustins.

U. S. Army Has Much to Learn About Motor Truck Preparedness

Metropolitan S. A. E. Hears Army Men and Transport Engineers on Lessons and Experiences of Warring Powers with Automobile and Motor Truck Branch of the Service

NEW YORK CITY, May 19—Armored cars and trucks were the chief topic of discussion at the May meeting of the Metropolitan section of the Society of Automobile Engineers held last evening at the service station of the International Motor Co. The subject of preparedness and the Automobile Reserve Corps was also discussed. About 100 were in attendance.

The United States has much to learn about motor truck preparedness from England, it developed from the addresses made by Captain Kilburn, who attended as the representative of Maj. Gen. Leonard Wood, commander of the department of the East, U. S. Army, and of Mr. Murden, who is in this country purchasing war material and who has had considerable practical experience with mechanical transport in the present war.

Showing the need for adequate preparation of motor transport equipment in times of peace, Captain Kilburn stated that the Mexican expedition of our army had been held up for 6 days because of the lack of motor trucks for the transport of troops and their supplies. He stated that had plentiful supplies of motor trucks been available the troops could have started in pursuit of Pancho Villa without delay and that by now the trouble would probably have been all over.

Segregation by Makes

According to Captain Kilburn, Captain Johnson, of the department of the East, who has been giving the subject of motor transport a great deal of study, has arrived at the conclusion that each division should be supplied with trucks of uniform make and that on account of the likelihood of our troops operating in rough country and also on account of the limited supporting capacity of our bridges and culverts the 1½-ton truck is regarded as the maximum size practicable.

That the new Automobile Reserve Corps law now in process of passage in Congress will permit the President to appoint any volunteer men or bodies of men to serve the army in case of need in the Quartermaster Department of the army was an interesting point brought out by Captain Kilburn, who also stated that this law would place no limits on numbers of such appointments.

Captain Kilburn emphasized the importance of organizing a large and efficient reserve of commercial vehicles available for service in case of war. He also urged the advisability of standardizing on given makes for each division. He stated that in the formation of the reserve corps, it was his opinion that the motor truck manufacturers must do the recruiting.

Value of Armored Trucks

Respecting armored trucks Captain Kilburn was sceptical as to their value inasmuch as they are dependent upon roads for operation and can very quickly be put out of action by well-directed artillery fire as they constitute excellent targets. He stated that up to the present such armored cars as have been experimented with in this country have been equipped with machine guns but that more effective work could be done with larger guns.

In connection with this he stated that it was planned to experiment with a 1-lb. automatic gun with a cushioning arrangement which absorbed practically all of the recoil.

In response to an inquiry concerning the standard of capacity set by the government, Captain Kilburn stated that it was possible that the maximum load of 1½ tons might be increased as a result of improved roads, bridges and culverts.

That Great Britain has found the 1½-ton truck too light; that it has determined that efforts to standardize detail design are undesirable and that a very effective motor reserve corps was in operation in that country before the war were the most interesting points brought out in a short talk by Mr. Murden.

In 1912 the British war office started to lay the ground work for a motor truck reserve. The War Office provisional subsidy provided that purchasers of such trucks were to receive a bounty of £70 per year—about $348—in return for their agreement to surrender their vehicles to the army in case of national emergency, and in the meantime to constantly carry a prescribed supply of spare parts on the trucks and to have them inspected by government inspectors at stated periods.

At the outbreak of the war, stated Mr. Murden, many thousands of these subsidy trucks were landed in France 48 hr. after the order of mobilization.

As to the segregation of makes into divisions, as proposed by Captain Kilburn, Mr. Murden stated that his government had not found this necessary, so long as individual convoys were made up of but one make, this being due largely to the subsidy standardization plan.

Going into the details of the subsidy plan, Mr. Murden stated that the subsidy agreement provided for reporting the trucks for duty at predetermined mobilization points on 24 hr. notice. It applies only to 3-ton trucks, 1½-ton types having been experimented with and discarded, inasmuch as army men loaded them with 3 tons anyway, and there was no apparent advantage in having the smaller capacity.

In respect to the tests, in response to an inquiry from one of his listeners, Mr. Murden stated that these cover a period of 1 month. Three days out of every week are spent on long and level runs, to test the ability of the trucks on sustained, heavy-duty service, the remaining 3 days on narrow, hilly, rough, soft and crooked roads. On all of these tests the trucks are fully loaded, the total weight being about 15,200 lb. One driver, a helper and a military observer accompany the truck.

The hood is locked at all times except for 15 min. each morning and 35 min. when gasoline and oil are being put in. Demerits are made for all excess time for repairs or adjustments, for defects and for failure to make the proper mileage. The trucks are equipped with governors set for 1100 r.p.m., and the speed limit is 16 m.p.h. Timed hill-climbs are made, and the temperature of the water at top and bottom noted. In the evening of each day 75 min. for work is allowed, with 1 demerit for each minute exceeded.

After 2000 miles have been covered, the governors are removed and the trucks are run at full speed for 3 hr. on Brooklands. The survivors of these tests are then taken down completely and each part minutely inspected for wear and defects in materials or workmanship.

Rear tires are dual 1050 by 140 mm. front tires being 1020 by 120 mm.

Urges Co-operation

Albert F. Masury, chief engineer of the International Motor Co. urged strongly that the S. A. E. appoint a committee to consult with the Motor Truck Club, explaining that the latter body had conducted some highly-illuminating experiments to show that the army's standard of 1½-ton capacity was too low, and that it had receommended that 5-tonners be used.

He then went on to tell about the battery of armored cars in various stages of completion which were drawn up on one side of the room in which the meeting was held, stating that they were to become the first armored motor battery of the National Guard of New York.

Mr. Masury also called attention to a new Mack 1½-ton transport truck fitted with the new Goodrich pneumatic truck tires on all wheels. These tires are of the low-pressure type, 38 by 5½ by 8. The three sizes refer to the three dimensions of the tire, namely, diameter, depth and width. They are straight-sided and on the rear have curved steel guards at the side to prevent excessive flattening if punctured and to protect the sides of the tire from chafing.

In line with the motion of Mr. Masury, it was voted to have the governing committee name a committee to assist the Motor Truck Club in its work and to study armored cars.

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Studebaker Adds 68,000 Ft.

DETROIT, MICH., May 22—The announcement has just been made public from the Studebaker offices of the closing of an important property purchase, which will result in factory extensions and a still further increase in car production.

The new property which is located between Campau and Scotten Avenues, adjoins the Studebaker plant No. 3 on the north, and embraces 68,000 sq. ft. At present seventeen residences stand on this site, and the work of tearing down these houses will be begun immediately.

With the annexing of this property, the Studebaker plant No. 3 space will extend from Fort Street to Jefferson Avenue. The Studebaker factories now cover more than 150 acres of space—108 acres of actual floorspace—and employ over 7000 men.

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Twin City Truck Makers Expand

MINNEAPOLIS, MINN., May 20—The Four Wheel Drive Mfg. Co., Minneapolis, and the Twin City Four Wheel Drive Co., St. Paul, are to begin making trucks under the J. L. Ware patents. The latter company is to occupy its new manufacturing plant at Cromwell and University Avenues next week. This company is capitalized at $500,000 and is headed by Mr. Ware. It is now manufacturing in cramped quarters.

The Minneapolis company, capitalized recently at $1,000,000, has bought the Nott Fire Engine Co. plant with 50,000 sq. ft., at Central and Eighteenth Avenues, Minneapolis, and in 90 days expects to turn out ten trucks a day, ranging from 2- to 4-ton. It reports a contract for 3000 trucks for delivery abroad in 2 years.

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Ward Elected to Defense Society

DETROIT, MICH., May 18—Artemas Ward, Jr., president of the King Motor Car Co., Detroit, has been selected as a member of the National Committee of the American Defense Society. This consists of well known men.

Electric Interests Convene

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Exhibition of Cars and Trucks —Study Quantity Production Opportunities

CHICAGO, ILL., May 22—The former Electric Vehicle Assn. of America, now the Electrical Vehicle Section of the National Electric Light Assn., held its first joint session with the parent body at the Auditorium and Congress hotels here this week. The sessions of the Electrical Vehicle section took place on Wednesday and Thursday simultaneously with the convention sessions. An exhibit was staged in the foyer and over a subflooring of the Auditorium theater. Several truck and passenger car makers and car equipment manufacturers of all kinds presented attractive booths. There were about sixty exhibits in all. The Walker Vehicle Co. of Chicago displayed a 1-ton chassis and a Walker balance drive exhibit unit opened to show the principle of motor inclosed in the rear axle housing driving through spur gears within the wheels. The General Vehicle Co., Inc., also showed a truck chassis. A chassis and a delivery car were in the booth of the Ward Motor Vehicle Co. Edison batteries were fitted in both. The only passenger car display was that of the Detroit Electric Co. which consisted of two handsomely appointed coupés.

Opportunity for Electrics

The present unusual opportunity for quantity production of electric passenger and commercial cars in competition with gasoline cars, due in a measure to the great strides in electric car perfection of the past 3 or 4 years, but especially to the now high and constantly soaring price of gasoline, was the subject upon which a majority of the section and committee reports and individual papers of the meetings were founded. In his paper on Electric Passenger Vehicle Problems and Activities, E. P. Chalfant summed up the reason for failure of the electric car manufacturers to establish themselves on a competitive plan with gasoline car makers as follows:

"The first reason is the failure of the manufacturers to properly educate the general public regarding the wonderful utility of the electric.

"The second reason is the failure of the central station to make it easy to own and operate the electric, by an adequate distribution of charging and boosting stations."

He makes the assertion that the gasoline car is but 5 per cent more efficient than the electric and attributes this 5 per cent to surplus with reference to power, radius, speed, energy and fuel.

"There was a time," said Mr. Chalfant, "when gasoline cost but 10 cents a gallon. About that same time it required about 10 hr. to recharge the cells of an electric, at an average of 8 cents per kilowatt-hour for current. Since then gasoline has advanced in most localities to a price above 30 cents a gallon and it is said to be on its way to 50, while electric juice has declined to an average of 5 cents per kilowatt-hour. To-day the constant potential charging system will bring the battery up to two-thirds of its capacity in 1½ hr.—a lunch time boost for instance—while a full charge requires but 3 hr. The ordinary charging station requires about 6 hr., and the motor generator set or the mercury arc rectifier installed in a private garage requires but little more.

The Cost of Power

The cost of power comparative between gasoline and electric cars was outlined by Mr. Chalfant as follows:

"Placing the daily mileage of each type at the conservative figure of 35 miles a day—1000 miles a month, statistics show that current for electrics averages $8.50 per month. Let us assume that a closed gasoline car, with six-cylinder motor of average power rating consumes gasoline at the rate of 8 m.p.g. at a cost of 30 cents per gallon and the expense for the month is $37.50, over four times the cost of current. Nor does it take into account the same proportionate expense for oils, greases and general repairs."

This argument was further strengthened in the paper given by William P. Kennedy on Central Station Promotion of Electric Vehicle Use. His plan embodies a battery service system added to the present power service and lighting service of central station organizations, the principal function of which would be to supply energy and maintain this type of energy consuming apparatus in working condition.

P. D. Wagoner's paper on Battery Service—A Unit in a Comprehensive Plan for the Successful Exploitation of the Electric Vehicle, detailed the use of duplicate batteries in commercial vehicles which is being successfully carried out in a large way in such cities as Hartford, Spokane, Boston, Baltimore, Harrisburg, San Francisco, Los Angeles, Worcester, Fall River and Wichita. The system, as now practised on the Geveco trucking system, calls for sale to the purchaser of a car less battery, the vehicle being supplied with a specially designed, detachable battery cradle. By the use of this interchangeable cradle the company furnishing power is enabled to exchange a discharged or partly discharged battery for a fully discharged one in from 2 to 5 min. The current used is sold by the mile, according to the size of the vehicle and amount

of mileage used as recorded by the odometer.

The paper on Greater Garage Service, by Harry Salvat, was a plea for more unity than now exists between the electric car manufacturer and garage owner.

F. E. Whitney's paper on Electric Truck Troubles and Means Taken to Eliminate Them, was an outline of the various troubles brought to light in the early electric vehicles and the remedies devised to eliminate them.

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Motor Castings Co. Organized

DETROIT, MICH., May 19—The Motor Castings Co. has recently been organized to manufacture cylinder castings only. The foundry is located on Hart Avenue near Mack Avenue, and the show room and general sales office has been opened at 997 Woodward Avenue. The officers of the company are J. D. Curry, president; E. H. Briggs, vice-president; W. T. Cullen, sales manager, and J. A. Lanigan, general manager.

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Fisk Strike Ends

SPRINGFIELD, MASS., May 21—The striking machinists and tire workers of the Fisk Rubber Co., Chicopee Falls, Mass., have accepted the latest propositions made by the company. Twenty-six hundred men will return to work. An 8-hr. day will go into effect at once. Time and one-half will be paid for overtime, and double time for Sundays and holidays.

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Hofer Goes to Ross Co.

DETROIT, MICH., May 22—Walter C. Hofer has resigned as special representative of the Lozier Motor Car Co. and has joined the Ross Automobile Co. as district manager of southwestern territory.

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McCord Joins Bankers Commercial Corp.

NEW YORK CITY, May 22—D. C. McCord has resigned his position as manager of Harris Brothers Co., Detroit, Mich., to become general manager of the Bankers Commercial Corp., this city, which finances installment sales.

First Armored Car Driver Dies

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De La Touloubre, Pioneer Race Driver, Was Crippled in Moroccan Campaign

PARIS, May 10—De La Touloubre, pioneer race driver and first man to take an armored car into battle, died at Paris this week, after having been partially paralyzed and dumb for 3 years. De La Touloubre was a prominent figure in all European road races from 1900 to 1908. An artillery captain in the French army, he had adopted the name of De La Touloubre for racing purposes only, his real name being Henri Genty. In the early days he was a member of the Darracq team together with Hemery and Wagner. He won his first important long-distance race on a Darracq light car in the Belgian Ardennes in 1904. Later he linked up with the Bayard-Clement team and had the late Albert Clement as one of his companion drivers.

De La Touloubre's most important work was the organization of an armored car corps of Panhards which took part in the Moroccan campaign of 1907 and following years. This is doubtless the first use ever made of armored cars in actual warfare. His armored cars were recognized to have rendered valuable service, but the campaign left him a physical wreck. While chasing the enemy the car he was driving fell down the El Kantara gorge. For a time De La Touloubre's life was in danger, but he recovered only to spend the last 3 years of his existence partially paralyzed and without the use of his voice. Before being lost to public view he published a book dealing with his armored car experiences in Morocco.

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Copper Prices Lowered

NEW YORK CITY, May 23—A drop of three-quarter cents a pound in copper featured the materials markets last week. This metal declined to 29¼ cents yesterday. Lead and tin prices which are very elastic, declined 7½ and 50 cents, respectively. The market in general was steady with few changes.

Open-hearth steel dropped to $42 a ton. Interest in the steel trade last week centred mainly in the placing of contracts for war munitions. Domestic automobile makers are still making a large demand for steel. Last week a contract of 250,000 tons of blue annealed sheets of steel was received from one of the manufacturers.

Rubber demand is apathetic. Para is quoting at 68¼ cents a lb., while Ceylon is steady at 70. American manufacturers of automobiles consume 36.3 per cent of the world's annual production of crude rubber, according to statistics. Allowing an average of 42 lb. of crude rubber for an automobile's tire equipment and taking 2250 lb. for the ton measure, the amount of rubber required by American-made automobiles in 1916 will be approximately 69,000 tons, as compared with an estimated total production of 192,000 tons. The rubber requirements for American automobiles in 1906 of 1866 tons have grown by leaps and bounds to 68,805 tons.

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To Oppose S. R. B. Reorganization

PHILADELPHIA, PA., May 20—A stockholders' protective committee has issued a letter asking for deposits of the Standard Roller Bearing Co. stock. The committee is composed of F. T. Aldridge, chairman; J. S. Stanton, F. P. Fiske and Merrill Bishop.

The letter says in part: "The immediate purpose of such deposits is to enable the committee to oppose in court or otherwise the proposed plan of reorganization set forth in the circular bearing date of April 21, 1916."

The committee objects to the terms of the reorganization plan including the five-year voting trust, and five-year option on $1,000,000 common stock at par. Deposits of stock before June 1 are requested by the committee with the Brooklyn Trust Co.

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Argo Buys Plant Site

JACKSON, MICH., May 23—The Argo Motor Co. has completed a deal with the Briscoe Motor Corp., whereby it has purchased the property which Mr. Briscoe purchased last year, upon which was to be erected a new plant for the Briscoe company, also a number of workmen's homes. All told, about 120 acres of ground are involved in this transaction. President Mansell Hackett of the Argo company announced that a new Argo plant will be started at once, and when completed the Detroit Chassis Co., in which he is strongly interested, will be moved to Jackson. In addition to the new plant for the Argo company, a number of homes for workmen will be built.

Daily Market Reports for the Past Week

Material	Tues.	Wed.	Thur.	Fri.	Sat.	Mon.	Week's Ch'ge
Aluminum, lb.	.58	.58	.58	.58	.58	.58	...
Antimony, lb.	.29½	.29½	.29½	.29½	.29½	.29½	...
Steel Beams and Channels, 100 lb.	2.77	2.77	2.77	2.77	2.77	2.77	...
Steel, Bessemer, ton	45.00	45.00	45.00	45.00	45.00	45.00	...
Copper, Elec., lb.	.30	.30	.30	.30	.30	.29¼	— .00¾
Copper, Lake, lb.	.30	.30	.30	.30	.30	.29¼	— .00¾
Oil, Cottonseed, bbl.	10.80	10.75	10.75	10.85	11.00	11.00	+ .20
Oil, Fish, Menhaden, Brown, gal.	.55	.55	.55	.55	.55	.55	...
Oil, Gasoline, Auto, bbl.	.24	.24	.24	.24	.24	.24	...
Oil, Lard, prime, gal.	1.10	1.10	1.10	1.10	1.10	1.10	...
Lead, 100 lb.	7.30	7.30	7.30	7.27½	7.27½	7.22½	— .07½
Oil, Linseed	.73	.73	.73	.73	.73	.73	...
Steel, Open-Hearth, ton	42.00	42.00	42.00	42.00	42.00	42.00	...
Oil, Petroleum, bbl., Kans., crude	1.55	1.55	1.55	1.55	1.55	1.55	...
Oil, Petroleum, bbl., Pa., crude	2.60	2.60	2.60	2.60	2.60	2.60	...
Oil, Rapeseed, refined, gal.	1.05	1.05	1.05	1.05	1.05	1.05	...
Rubber, Fine Up-River, Para, lb.	.68	.68	.68	.68	.68	.68¼	+ .00¼
Rubber, Ceylon, First Latex	.70	.70	.70	.70	.70	.70	...
Sulphuric Acid, 60 Baume, 100 lb.	3.00	3.00	3.00	3.00	3.00	3.00	...
Tin, 100 lb.	49.38	49.38	49.38	49.38	49.38	48.88	— .50
Tire Scrap, lb.	.05½	.05½	.05½	.05½	.05½	.05½	...

Paige Features Securities

Rises 230 Points on Announcement of 80 Per Cent Dividend

NEW YORK CITY, May 24—Paige-Detroit featured the securities market last week with a rise of 230 points on the strength of the announcement that action would be taken by the company on an 80-per cent stock dividend. The market as a whole was unusually strong with Chevrolet, Miller Rubber, Packard, Reo Truck, and New Departure showing substantial gains. Chevrolet rose 15 points, Miller Rubber 45, Packard common 39, Reo Truck 7½, and New Departure 60.

Chandler's New High

Chandler Motor has been an active participant in the recent advance in the automobile securities market and sold to a new high of 98.

United Stock Oversubscribed

Dominick & Dominick, syndicate managers of the United Motor Corp. financing, who have been receiving public subscriptions for that stock at $62 a share, report that the subscription, which closed last Saturday, was twice oversubscribed. Application will shortly be made to list the shares of this corporation on the local curb market. Subsequently application will be made to list the stock on the Stock Exchange. Two shares of United are offered for one of Perlman.

Rumors emanating from Wall Street state that the Willys-Overland Co. will pay in July a somewhat higher cash dividend and also an extra stock dividend on its common stock. The rate now being paid on the common is 6 per cent regular, although in 1915 an extra 5 per cent was paid in stock.

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Torrington Co. to Distribute Splitdorf Electrical Co. Shares

NEWARK, N. J., May 19—The directors of the Torrington Co. have voted to distribute to the common stockholders the preferred and common shares of the Splitdorf Electrical Co. now held in the Torrington Co.'s treasury. There are 9800 shares of Splitdorf preferred and 14,000 common held, and each share of Torrington common will receive seven one-hundredths of a share of preferred and one-tenth of a share of common. Distribution will be made July 1.

Until recently there have been 28 per cent accumulated dividends on the Splitdorf preferred. A few weeks ago 7 per cent was paid; then came another 7 per cent, and by June 1 the 28 per cent will have been made up.

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Frost Is Westcott Service Manager

DETROIT, MICH., May 22—Allen H. Frost has resigned as factory manager of the Detroit Wire Spring Co., to become service manager of the Westcott Motor Car Co., Richmond, Ind. This corporation will move to Springfield, Ohio, next month.

Drivers Tune Up at Indianapolis

Aitken, Rickenbacher and Oldfield Make Fast Time in Practice Laps

INDIANAPOLIS, IND., May 21—Although but five cars have been reeling off practice laps at the Indianapolis Speedway, a steady crowd of bleacherites are on hand every day. Yesterday, being Sunday, about 1800 turned out in spite of the weather and saw some fast time made by Johnny Aitken and Eddie Rickenbacher. Each of these drivers made the circuit in 1:34, or at over 95 m.p.h. Barney Oldfield sent his car around for a lap in just over 1:35, but on the succeeding lap had to be towed by Rickenbacher. Examination showed that his Delage had a broken valve rocker arm. This is now being repaired.

Rickenbacher had a little engine trouble to-day, but will be out again in the morning. The car he was driving yesterday was not his own but that of his team-mate, Pete Henderson, who is laid up temporarily with a slight illness.

Resta and Christiaens of Peugeot and Sunbeam fame are both repairing their motors, which suffered in the recent Sheepshead Bay event. One of the reasons that the drivers are so late getting to Indianapolis this year is because they had ample opportunity to try out their mounts in New York, and those who are not repairing their cars are resting

Automobile Securities Quotations on the New York and Detroit Exchanges

	1915 Bid	1915 Asked	1916 Bid	1916 Asked	Wk's Ch'ge
Ajax Rubber Co. (new)	..	..	66	68	..
Aluminum Castings pfd	98	100	..	..	..
J. I. Case pfd	76	82	86	90	—1
Chalmers Motor Co. com	90	93	160	165	+5
Chalmers Motor Co. pfd	95	98	96	100	—2
Chandler Motor Car Co	..	..	96½	97½	..
Chevrolet Motor Co	..	..	231	234	+15
Electric Storage Battery Co	80	88	64	65	+4
Firestone Tire & Rubber Co. com	..	485	830	860	..
Firestone Tire & Rubber Co. pfd	110	112½	113	114	..
General Motors Co. com	135	137	431	460	—29
General Motors Co. pfd	97	100	116½	117	—1½
B. F. Goodrich Co. com	443	451	75¾	76¼	—2
B. F. Goodrich Co. pfd	101¼	102½	115	118⅜	..
Goodyear Tire & Rubber Co. com	225	235	380	385	..
Goodyear Tire & Rubber Co. pfd	105	106½	105	106	— ½
Grant Motor Car Co	..	..	11	11½	..
Gray & Davis, Inc., pfd	..	..	..	..	..
International Motor Co. com	12	14	10	15	+3
International Motor Co. pfd	30	33	22	27½	+1
Kelly-Springfield Tire Co. com	124	128	74	74½	— ¼
Kelly-Springfield Tire Co. 1st pfd	81	83	96	97½	—1
Kelly-Springfield Tire Co. 2nd pfd	115	130	..	..	..
Maxwell Motor Co. com	39	41	86	86½	+ ½
Maxwell Motor Co. 1st pfd	82	83	88½	89	—1
Maxwell Motor Co. 2nd pfd	34	36	57½	58	—1½
Miller Rubber Co. com	180	188	300	..	+45
Miller Rubber Co. pfd	104	105	115	..	..
New Departure Mfg. Co. com	136	141	277	278	+60
New Departure Mfg. Co. pfd	106	..	113	..	—1
Packard Motor Car Co. com	..	104	204	210	+39
Packard Motor Car Co. pfd	98	..	100	105	..
Paige-Detroit Motor Car	..	..	980	1050	+230
Peerless Motor & Truck Corp	..	..	20	21	—3½
Perlman Rim Corp	..	..	128	130	..
Portage Rubber Co. com	35	38	85	88	..
Portage Rubber Co. pfd	85	88	107½	108½	..
Regal Motor Co. pfd	..	..	20	..	+2
*Reo Motor Truck Co	15	15¾	37	38	+7½
*Reo Motor Car Co	32¾	..	44½	45	+2
Saxon Motor Car Co	..	..	73½	74	..
Splitdorf Electric Co. pfd	..	..	..	..	..
Standard Motor Co	..	..	8	8¼	..
Stewart-Warner Speed. Corp. com	64	65	88	90	+1
Stewart-Warner Speed Corp. pfd	102	105	109	111	..
Studebaker Corporation com	65	67	137¼	137¾	—3¾
Studebaker Corporation pfd	96	98	109	112	..
Swinehart Tire & Rubber Co	80	90	83	84	..
Texas Company	123	124	191	193	—1
United Motor Corp	..	..	63½	64	..
U. S. Rubber Co. com	61	63	54¾	55¼	— ¾
U. S. Rubber Co. pfd	104¼	106¼	109	110	+2
Vacuum Oil Co	195	205	243	246	+6
White Motor Co. (new)	..	..	51½	51¾	+1½
Willys-Overland Co. com	111	113	259	262	—5
Willys-Overland Co. pfd	99⅛	102	106	107	+1

OFFICIAL QUOTATIONS OF THE DETROIT STOCK EXCHANGE

ACTIVE STOCKS

	1915 Bid	1915 Asked	1916 Bid	1916 Asked	Wk's Ch'ge
Auto Body Co	..	..	..	34	..
Chalmers Motor Co. com	89	92	162½	..	..
Chalmers Motor Co. pfd	94	97	96	100½	..
Continental Motor Co. com	..	185	37½	38¾	+1¼
Continental Motor Co. pfd	84	85½	9½	10½	+ ¼
Ford Motor Co. of Canada	900	..	..	405	—5
General Motors Co. com	137	139	430	460	..
General Motors Co. pfd	98	101	116	118	— ½
Maxwell Motor Co. com	40	42	85	88	+1½
Maxwell Motor Co. 1st pfd	83	84½	89	91	..
Maxwell Motor Co. 2nd pfd	35	36½	55	57	—3
Packard Motor Car Co. com	..	104	206	..	..
Packard Motor Car Co. pfd	..	100½	101	..	..
Paige-Detroit Motor Car Co. new	..	..	55	56½	..
Paige-Detroit Motor Car Co. old	..	..	980	1050	..
*Reo Motor Car Co	32¾	33¾	44½	45¼	+1¼
*Reo Motor Truck Co	15	15¾	36	37½	+7¼
Studebaker Corp. pfd	..	..	108	..	..
Studebaker Corp. com	66	..	135	138	+1
*W. K. Prudden Co	19½	21	48	49½	+14½

INACTIVE STOCKS

*Atlas Drop Forge Co	..	26	28½	40	..
Kelsey Wheel Co	200	..	340	350	..
Regal Motor Car Co. pfd	..	25	16	13	..

*Par value $10.

in the interval before the 300-mile event which takes place on Decoration Day.

Repeated attempts to get post entries in the race have brought forth an official announcement from Manager Myers of the speedway that under no conditions will post entries be permitted. This reply has been made to Ira Vail, who tried to get in with his Hudson; De Palma with his Mercedes; to the Brooklyn owners of the Adams Special and Olsen Special cars; the Super-six Hudson that Mulford tried to get in, and a car from Detroit.

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Hyatt Service Managers Meet

DETROIT, MICH., May 20—Hyatt service managers from every city in the country where there is a Hyatt branch closed their first annual convention to-day at the offices of the Hyatt company in this city.

Those present at the sessions, which began 2 days ago, were: J. J. Hanrahan, Los Angeles, Cal., representing the three Hyatt branches on the coast; J. W. Hutchinson, Boston, Mass.; L. R. Remington, Chicago, Ill.; R. B. Campbell, Atlanta, Ga.; K. H. McQueen, Newark, N. J.; N. S. Swan, Minneapolis, Minn.; H. Jay, Detroit, together with Service Supervisor A. K. Hebner; R. C. Brower, recently appointed traveling supervisor; J. W. Taylor, assistant service supervisor, and A. W. Robbins, assistant service manager at Detroit.

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Venice Plans 100-Mile Race

VENICE, CAL., May 16—Plans are under way for a 100 mile race on the Venice road race course limited to cars of 231 cu. in. and under. The date suggested for the proposed event is July 4.

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Reliability Run For Trucks

SAN DIEGO, CAL., May 17—July 15 and 16 are the dates set aside for the Los Angeles to San Diego motor truck reliability tour being promoted by the Los Angeles truck dealers under A. A. A. sanction. The trucks are to carry California products on the run.

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Invoke Bay State Blue Law

SPRINGFIELD, MASS., May 20—As a result of the legislature not passing the law to allow the sale of gasoline and tires, etc., on Sunday the police here have notified the garage men that they must obey the law. Under the law a motorist cannot buy gasoline, tires, etc., and if he runs short of fuel and has a couple of punctures and has no extra tubes he may be marooned in a garage all night. The only alternative would be to borrow a tube or some fuel from a passing motorist.

$13,500 to Champion Drivers

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Goodrich Adds $10,000 to Bosch Prizes for Three Leaders

NEW YORK CITY, May 18—Thirteen thousand five hundred dollars will be distributed by the Contest Board of the American Automobile Assn., to the champion automobile racing driver and the next two to finish in the championship award table during 1916. In addition thereto there will be a $1,000 cup.

The champion automobile racer of America will be officially declared this year by the A. A. A. and he will be awarded the cup and $7,000; to driver scoring second position, $4,000 will be given; and third position will receive $2,500.

Back of this cash offer are the B. F. Goodrich Co., and the Bosch Magneto Co. The Goodrich company will give $10,000, divided into $5,000, $3,000 and $2,000; and the Bosch company, as announced last month, will give $3,500 divided into $2,000, $1,000 and $500 and a $1,000 cup.

The championship award will be made according to a points system evolved by the Contest Board. The first of the championship events was the Metropolitan Cup Race at the Sheepshead Bay Speedway on May 13, which was won by Rickenbacher in a Maxwell. The standing of the first five as a result of this race is as follows:

Driver	Car	Points
E. V. Rickenbacher	Maxwell	600
Jules Devigne	Delage	320
Ira Vail	Hudson	170
C. J. Devlin	Duesenberg	90
George Adams	Adams	55
Bert Watson	J. J. R.	35

The 300-mile race at Indianapolis on Decoration Day is the next championship race and after that comes the 300-mile race at the Chicago speedway on June 10 and the 150-mile race at Des Moines on June 26.

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Saxon Makes 34 M. P. G. in Spokane Fuel Economy Run

SPOKANE, WASH., May 18—The first economy run ever staged by Spokane automobile dealers was the feature event of the second annual Spokane automobile show. Sixteen cars competed in five classes, all the entrants showing exceptional ability to go many miles on 1 gal. of gasoline.

Before starting each car was fitted with a special gasoline tank, which was filled with 3 gal. of gasoline, and every car made the 37.5 mile run on less than the 3 gal.

To the Saxon goes the honor of making the best showing. With a piston displacement of less than 100 cu. in., it used just a little more than 1 gal. of gasoline, the car traveling at the rate of 34 m.p.g.

In the next class the Maxwell was the winner, averaging 29.3 m.p.g. The Buick light six roadster led its field, averaging 26.6 m.p.g.

In division No. 6, the class in which there was the greatest number of entrants, the Reo four, driven by Herb Alderson, was the winner. It averaged 25.4 m.p.g.

C. A. Martin driving a Paige six roadster was a winner over the Studebaker in the large car class, averaging a little better than 16.5 m.p.g.

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To Renew Desert Classic

LOS ANGELES, CAL., May 17—Interest in the revival of the Los Angeles-to-Phoenix Road Race is growing. Four entrees have been promised already, in case the desert classic is staged this fall and in each case, no reference has been made to prize money, indicating a sporting angle which was largely responsible for the success of the first desert races.

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Vanderbilt and Grand Prize in Nov.

LOS ANGELES, CAL., May 22—The dates for the Vanderbilt Cup and International Grand Prize races at Santa Monica will be Nov. 16 and 18, respectively.

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Yellowstone Park Tour July 20

DENVER, COL., May 18—The Yellowstone National Park Tour will start from Minneapolis, Minn., July 20. The tour will be to Yellowstone Park by way of Fargo, Bismarck, Dickinson, N. D., Medora, N. D., Miles City, Mont., Forsyth, Billings, Livingstone and Gardner. A hotel train on the Northern Pacific Railroad will follow the tour, supplying accommodations and carrying a complete repair shop.

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Racers Used Magnalite Pistons

NEW YORK CITY, May 22—In the equipment table of the cars in the Sheepshead Bay race last week it was stated that the two Delage cars driven by Limberg and Devigne used steel pistons. These cars were equipped with Magnalite pistons made by the Walker M. Levett Co., New York City. Magnalium piston equipment was given for Lecain's Delage, Devlin's Duesenberg, Resta's Peugeot, Rickenbacher's and Henderson's Maxwells, Watson's J.J.R., the Adams Special, the two Crawfords and the two Erwin Forties. All these cars also used Magnalite pistons.

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British Industries Fair in 1917

LONDON, May 20—The Board of Trade has decided to hold the British Industries Fair in London next year from Feb. 26 to March 9, inclusive. Participation in the fair will be confined to manufacturers.

Factory Miscellany

Ford to Add in London—The Ford Motor Co. will add to its factory in London, Ont. The estimated cost is $75,000.

Douglas & Rudd Doubles Capacity—The Douglas & Rudd Mfg. Co., Bronson, Mich., maker of automobile accessories, has let contracts for an addition to its plant that will more than double its capacity.

Ford Plant in Chicago—The Ford Motor Co., Chicago, Ill., has let the contract for an additional plant in connection with its assembling plant in that city, which will be 56 by 365 ft., two stories, and will cost $60,000.

Elizabeth Co. to Build—The Elizabeth Auto Body Co., Elizabeth, N. J., will erect a plant, 100 by 100 ft., on South Spring Street, and an engine room, 40 by 40 ft.

Begg Motor to Add—The Begg Motor Co., Vancouver, B. C., will have an addition built at its plant immediately at a cost of $15,000.

Standard Truck to Build—The Standard Motor Truck Co., Detroit, will build a three-story reinforced concrete factory, 130 by 153 ft., to cost $50,000.

Takes Over Top Dept.—The Auto Vehicle Parts Co., Cincinnati, Ohio, has made a deal with the Higgin Mfg. Co., Newport, Ky., to take over its carriage top trimming department. The business will be removed to Cincinnati as soon as arrangements can be made.

Inter-State to Enlarge—Tentative plans are being made by the Inter-State Motor Co., Muncie, Ind., to build an addition to the plant this summer, 800 by 50 ft., and two stories high. This will give the factory approximately 350,000 sq. ft. of floor space. Two large enameling ovens have recently been installed.

Wis. Factory News—The Federal Rubber Co., Chicopee Falls, Mass., has filed articles and a statement to do business in Wisconsin. Of the $10,000,000 capital, $2,000,000 is represented by Wisconsin holdings, consisting of the property of the Federal Rubber Mfg. Co., Milwaukee, which recently disposed of its business to the Fisk interests, as noted at the time. The Wisconsin corporation will be dissolved and lose its identity. As has already been stated, the main plant at Cudahy, Milwaukee County, will be nearly doubled in size during this year.

The Continental Motor Truck Co., Superior, which engaged in the manufacture of motor trucks more than a year ago, is preparing to spend $50,000 in the erection of a factory of its own. The moving spirit of the company is Dr. John G. Barnsdale, 618 Tower Avenue, who designed the car, which has been manufactured on a small scale. Under the enlarged facilities, the truck will be built in four sizes and a large production attained.

The Perfex Radiator Co., Racine, a large manufacturer of radiators for passenger cars, trucks and tractors, is preparing to build a plant of its own. Plans have been prepared for the first unit, to be 65 by 250 ft. in size, one story high, of fireproof construction, to be ready during mid-summer. The company has been occupying leased quarters for several years, but these have been outgrown. G. W. Bartlett is president.

Ohio Seamless Tube Adds—The Ohio Seamless Tube Co., Shelby, Ohio, has purchased a building site and has started the erection of an entirely new plant in addition to its present plant, for the manufacture of seamless cold drawn and hot finished tubes. This mill will have a capacity of 2000 tons per month. The combined capacity of all of the mills of the company, when completed, will be 4000 tons per month. This new plant will be in operation Dec. 1.

Tracy Adds to Plant—Additional apparatus has been recently installed at the motor testing plant of Joseph Tracy, including a late model high-speed Sprague electric dynamometer, two hydraulic brakes and a chassis testing machine of the rear wheel type.

The Automobile Calendar

ASSOCIATIONS

May 22-26—Chicago, Ill., N. E. L. A. Convention, Electric Veh. Section, Congress Hotel.

May 26-27—Del Monte, Cal., Meeting, Three Divisions of National Assn. of Automobile Accessory Jobbers.

June 12-16—S. A. E. Summer Trip on Great Lakes.

July 2-6—Detroit, Mich., World's Salesmanship Congress, Detroit Board of Commerce Bldg.

Dec. 2-9—Electricians' Country-wide Celebration.

CONTESTS

May 30—Des Moines, Iowa, Iowa Derby, 20 miles; Des Moines Special, 10 miles.

May 30—Tacoma, Wash., 10, 20, and 30-Mile Races, Tacoma Speedway Assn.

May 30—Elmira, N. Y., Track Race, Elmira Auto & Motorcycle Racing Assn.

May 30—Indianapolis Speedway 300-Mile Race.

May 30 — Minneapolis, Minn., Speedway Race.

May 30—Newark, N. J., Track Race, Olympic Park Racing Assn.

June 4—Sheepshead Bay Speedway, 30-mile Race, American Liberty Day Committee.

June 10 — Chicago Speedway Race. International 300-Mile Race, Speedway Park, Speedway Park Assn.

June 16-17 — Sheepshead Bay Speedway, 24-Hr. Race, Trade Racing Assn., New York City.

June 20—Galesburg, Ill., Track Race, 100 miles.

June 28—Des Moines, Iowa, Speedway Free - for - All, 300 Mile Race.

July—LaGrande, Ore., Track Race, LaGrande Motor Club.

July 4—Coeur d'Alene, Idaho, Race Meet, Hiller-Riegel Co.

July 4—Tacoma, Wash, Speedway Race, Tacoma Speedway Assn.

July 4—Minneapolis 300 - Mile Speedway Race.

July 4—Sioux City Speedway Race.

July 4—Newark, N. J., Track Race, Olympic Park, Auto Racing Assn.

July 15—Omaha, Neb., Speedway Race.

July 15—North Yakima, Wash., Track Race, Hillier-Riegel Co.

Aug. 5—Tacoma Speedway Race, Tacoma Speedway Assn.

Aug. 11-12—Pikes Peak, Col., Hill Climb, Pikes Peak Auto Highway Co.

Aug. 12—Portland, Ore., Track Race, Hillier-Riegel Co.

Aug. 18-19—Elgin Road Race, Chicago Auto Club.

Sept. 4—Newark, N. J., Track Race, Olympic Park, Racing Assn.

Sept. 4—Des Moines Speedway Invitation Race. Limited to six entries.

Sept. 4—Indianapolis Speedway Race.

Sept. 4-5 — Spokane, Wash., Track Race, Inland Auto Assn.

Sept. 16—Providence Speedway Race.

Sept. 29—Trenton, N. J., Inter-State Fair. H. P. Murphy, Racing Sec.

Sept. 30 — New York City, Sheepshead Bay Speedway Race.

Oct. 7—Philadelphia Speedway Race.

Oct. 7—Omaha Speedway Race.

Oct. 14—Chicago Speedway Race.

Oct. 19—Indianapolis, Ind., Race, Indianapolis Motor Speedway.

Nov.—Santa Monica, Cal., Vanderbilt Cup and Grand Prix Races.

GOOD ROADS

Sept. 6-7—St. Paul, Minn., Good Roads Congress, Auditorium.

MISCELLANEOUS

June 8—New York City, Orphans' Day Outing at Donnelly's Grove, College Point, L. I. Orphans' Automobile Day Outing Assn.

SHOWS

Sept. 2-9—Columbus, Ohio, Fall Show, Ohio State Fair, Columbus Automobile Show Co.

TRACTOR

July 17-21—Dallas, Tex., Tractor Demonstration.

July 24-28—Hutchinson, Kan., Tractor Demonstration.

July 31-Aug. 4—St. Louis, Mo., Tractor Demonstration.

Aug. 7-11—Fremont, Neb., Tractor Demonstration.

Aug. 14-18—Cedar Rapids, Iowa, Tractor Demonstration.

Aug. 21-25—Bloomington, Ill., Tractor Demonstration.

Aug. 28-Sept. 1—Indiana Tractor Demonstration.

Sept. 4-8—Madison, Wis., Tractor Demonstration.

Sept. 11-16—Milwaukee, Wis., Fall Show, Wisconsin State Fair, Milwaukee Automobile Dealers.

The Week in the Industry

Trade Happenings

New York City Trade Items—The P. J. Durham Co., 244 West Forty-ninth Street, has added the Willard storage battery service station to its equipment, in addition to its present work as official service representative for the Electric Auto-Lite Co., Toledo, Ohio, and Gray & Davis, Boston.

The Redden Motor Truck Co. has moved its office and showroom to the Locomobile Building, Sixty-first Street. C. A. Redden, president of the company, recently moved the general offices of the company to 676 Woodward Avenue, Detroit, and will divide his time between these two cities.

The organization of the Colonial Motors, Inc., which was recently formed by J. F. Plummer, former local Locomobile manager, to distribute the Liberty car, has been completed. Arnold Wood is vice-president, H. B. Van Loan is secretary and treasurer, J. L. Bailey is sales manager, and L. W. Beck is service manager.

Robert Lurie & Co., Metz distributor, is now located at 240 West Fifty-sixth Street. The wholesale department is to be placed in operation with W. L. Schmidt; formerly of the International Motor Truck Co., in charge.

Charles Rifenberg, who for a time managed the service station of the King Motor Co., will superintend the service station of the C. T. Silver Motor Co., Overland distributor in Bronx.

E. J. Stern has taken on the agency for the Palmer-Moore truck, with an office at 1777 Broadway.

W. J. Taylor has joined the C. H. Washburne Corp., Moline-Knight distributor, as sales manager and efficiency expert. Mr. Taylor entered the Overland company in 1914 as efficiency engineer. Last year he joined the C. T. Silver Motor Co. and continued on the same work.

The Glidden Motor & Supply Co. has leased the building at 604 West Forty-seventh Street and the Dayton Rubber Mfg. Co. has leased the store at 1764 Broadway.

Columbus News Items—The Buckeye Tire & Supply Co., 75 North Fourth Street, has been made central Ohio distributor for Portage tires and tubes.

The Willys-Overland Co. will take over the central Ohio agency for the Overland June 1 and operate a branch house in the Buckeye capital. The agency had been handled for eight years by O. G. Roberts & Co. The branch service house will remain at the former location of the Roberts Co., 933 East Gay Street. A salesroom will be opened in the downtown automobile section. The manager of the Columbus branch has not been announced.

The Times Square Automobile Co. has opened a store for parts and accessories in South High Street.

The F. L. Chase Co., 390 North High Street, has taken the central Ohio agency for the Mac kand Saurer trucks.

The C. N. Bowen Motor Sales Co., 138 East Spring Street has taken the central Ohio agency for the Lexington.

C. E. Barr, one of the best-known automobile salesmen in central Ohio, has been made general manager of the Central West Motor Car Co., 80 North Fourth Street, agent for the Oakland.

The Campbell-Gilchrist Rubber Co. is the name of a new concern at 15 North Fourth Street, to handle Pennsylvania tires in Central Ohio.

The dealers in electrics in Columbus have united in a campaign of advertising to boost the sale of electrics at this time. Those who are participating in the campaign are Michael Abel, agent for the Baker, Rauch & Lang; F. E. Avery & Son, agent for the Detroit, and the Standard Motor Car Co., agent for the Milburn Electric.

The Willys-Overland Co., which will establish a Columbus branch June 1, has taken a lease on a large salesroom at Fourth and Gay Streets, which lies in the heart of the automobile district. The service station will remain at 933 East Gay Street, where the O. G. Roberts Co., former agents in central Ohio, was located. Samuel Isaacs, formerly with the Roberts company, will be in charge of the Columbus branch.

Power Barley District Sales Mgr.—Jos. R. Power has severed his connection with the Anderson Electric Car Co., Detroit, Mich., to accept a position as district sales manager with the Barley Mfg. Co., Streator, Ill., manufacturer of the Roamer car.

L. C. Mulford, who for a number of years has been identified with the automobile industry and who for the past 2 years has been traveling representative for the Barley Mfg. Co., Streator, Ill., has taken over the distribution in central Illinois of the Halladay models and the Roamer, which are the products of the Barley company. He will have headquarters in Streator.

Detroit Changes—A. A. Lehr, formerly assistant purchasing agent for the General Motors Co., and at one time connected with the purchasing department of the Studebaker Corp., has been appointed sales manager of the American Distributing Co., Detroit.

E. J. Curren, formerly assistant sales manager of the King Motor Car Co. and also of the Paige-Detroit Motor Car Co., has joined the sales promotion division of the Regal Motor Car Co.

New England Trade Items—An agency for the Lexington Six has been placed in Boston, Mass., with the Standard Automobile Co., that has the Standard Eight.

The Henshaw Motor Co., that has eastern Massachusetts for Dodge Bros. cars, has just opened a sub-agency at Brockton, and it has also leased a larger building for its Worcester branch. The company is planning a larger service station at Boston.

M. A. Potter, until recently with the New England branch of the Firestone Tire & Rubber Co., at Boston, has been appointed Eastern manager for the Werner-Lenz Co., Chicago.

G. H. Schuster, who won the New York to Paris race with the Thomas some years ago and who was with the Pierce-Arrow factory, has gone to Boston to take charge of the Dodge Bros. service station there and at Worcester. He will be supervisor of the stations in eastern Massachusetts.

J. S. Downey, who was prominent in motor racing circles some years ago, has bought an interest in the Massachusetts Storage Warehouse Co.

G. S. Whelan, formerly manager of the Grant car agency at Boston, has been placed in charge of the Munroe car agency just opened at that city.

C. W. Flynn, for some time manager of the Stamford, Conn., branch of the Chevrolet, has accepted a position as sales manager of the Inter-State Motor Co., Boston.

Scott Joins H. & N Carburetor—The H & N Carburetor Co., 1790 Broadway, New York City, announces the appointment of J. Arthur Scott as manager of its Pacific Coast branch.

Mr. Scott, who is well known to the trade as an expert gas engine man, held a similar position to that of his new appointment with the Master Carburetor Co.

The new branch office will be located at 617 South Olive Street, Los Angeles.